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Introduction

In 2018, in Poland, almost 75% of female students and 50% of male students in secondary schools declared their intention to continue their education at university ([Centrum Badania Opinii Społecznej, Public Opinion Research Center] CBOS, 2019a). In 2020 (Eurostat data, bit.ly/3ppSAM2), 58% of women and 37% of men aged 30–34 had completed tertiary education. Women accounted for 63% of graduates, 68% of postgraduates, and 53% of doctoral students ([Statistics Poland, Główny Urząd Statystyczny] GUS, 2021b). However, if we look back in time, we can see that the structure of education did not always develop in this way. Although there were no formal restrictions on women's access to primary education, it was not until the end of the 19th century that women were allowed to continue their education at secondary level. In the 20th century, for the first time in the history of Western civilisation, women were given the full right to free access to higher education. With each successive generation, more and more women climbed the ranks of the educational system, benefiting from the ending of men monopolising education, which for centuries had given them all the privileges that went with it. With time, women began to prevail in secondary schools and, when institutional possibilities arose, in higher education too. At the same time, men in Poland were more likely to opt for vocational education and training. Even when access to university became easier, their educational aspirations were less likely to include a degree level. By the turn of the 21st century, intergenerational differences in school choice had led to a clear gender gap in higher education. It was only over the course of a century that women moved from the margins of the education system to its centre, and then even to its dominance.

The "bird's eye view" perspective adopted during the analysis of the main tiers of the education system does not show the full differentiation of educational paths for women and men. A closer examination reveals that changes have not been equally large in all dimensions of the education system. The increase in the number of women in higher education contrast with of relatively stable, and certainly much slower to change, patterns of horizontal selection by gender. Males are continually overrepresented in engineering, technical and, in recent years, new technology fields and are more likely to pursue mathematics at lower levels of education. In the universally accessible education system, gender differences move at two speeds – faster in terms of access to levels of education and slower in terms of the selection of fields of study. This means that women outnumber men in tertiary education but are also more likely than men to opt out of educational pathways where mathematics is an important component. This leads, among other things, to women being over-represented in the service, education, and health sectors, while they are under-represented in the IT, engineering, and technology sectors.

For many social scientists, especially those concerned with social hierarchies, gender was not always a key feature differentiating access to education. Most of the traditional sociological and educational studies have focused primarily on the influence of the student's social status on their school performance, and their educational opportunities, considering gender as less important factor of educational inequalities. The emergence of a gap between men and women in education has shifted gender to the centre of researchers' interests. This has happened not only because women's advancement represents an unprecedented example of reversing one of the key dimensions of social stratification but also because increasing female educational attainment influenced their position in society, family and on the labour market. These include increased opportunities to get and keep a job, higher and relatively predictable earnings, and a lower risk of unemployment. For example, in 2017 women with a university degree made up almost 45% of female labour force, compared to 27% for men (GUS, 2018c). The increase in women's educational attainment also has an impact on issues that do not seem to be directly related to the school experience such as the decision about marriage, motherhood and its timing, or the planned number of children. The educational advantage of successive generations of women has also had the effect of reversing the traditional order in households, where men, thanks to their educational advantage, had previously been the heads of the family. This change did not always go hand in hand with ending the male monopoly on providing for the family, since even before educational opportunities were opened up, women were employed to varying degrees and earned some income. However, it is only the attainment of a certain level of education that has improved the economic position of younger generations of women, giving them greater job security and thus a more significant and predictable share of the household budget. Economic independence, which enables women to consciously shape their own biographies, has become a pillar of women's psychological and social subjectivity.

The causes of different educational attainments of women and men are as diverse as its effects. This is evidenced by the fact that, over the past few decades, various academic disciplines have been involved in trying to understand where this phenomenon comes from and how it evolves: psychologists have examined various aspects of the effect of individual differences; sociologists have highlighted the importance of the gender role and environment in shaping gendered attitudes towards education; economists have analysed education-related choices in terms of the trade-offs between individual resources and possible benefits; and educationalists have studied the impact of the school environment on shaping the preferences of male and female students.

In writing this book, I have been guided by the conviction that an understanding of the differences in educational choices between men and women requires the broadest possible framing of the problem. Given that the process of differentiating the structure of educational attainment between the two genders spanned several generations, I begin my analysis by examining women's education in the 19th century (especially its second half). This is a journey into the distant past for sociologists accustomed to studying current phenomena, and occurring "here and now". But it was only by turning back the clock that I could better understand the convoluted circumstances of this historical change. Historians will not find in the first chapter any revealing conclusions about the mechanisms of women's entry into the educational system – the analyses presented there are based on material well-known to those who study the subject. Nor is this section intended to be a complete, fact-based synthesis of the process of women's emancipation in formal education. The content of the chapter describing the situation of women in the second half of the 19th century was selected to best illustrate the differing social status of men and women on the eve of universal education. Starting the analyses in the midst of the "steam and electricity" era also allows to link women's growing educational aspirations to a wider context. The insatiable political appetite of the powers of the day, the slow erosion of the social class structure, the emergence of new social classes with different expectations and ways of life, the effects of industrialization, the transformation of agrarian property in Europe, and the mass migration from rural to urban areas all prepare the ground for equal access to education.

The journey into the past, this time not so distant, continues in Chapter 2, wherein I have reconstructed the school biographies of the generations born in the 20th century and illustrated those patterns using census data. This analysis allowed me to place the emergence of gender gap in education on a historical timeline and connect them with wider social contexts. The changes in education policy after the World War II were an important factor contributing to the gender gap. Although the school system has transformed from elitist to more egalitarian, it has also created favourable conditions for the emergence of the gender gap. This was mainly due to the processes which took place at secondary school, where primary school leavers were grouped according to social status, ability and, as the analyses showed, gender. In each generation of primary school graduates during the socialist period, boys were more likely to pursue basic vocational education, while girls were more likely to choose matriculation schools. These patterns, reproduced by successive generations of students, allowed women to relatively quickly make up for the educational shortfalls/deficits that arose in the previous century. In the mid-1970s, women already made up over 50% of all students, and this advantage has grown systematically in the following decades.

The growing gender gap in education coincided with a torrent of political, social, and economic changes that Polish society underwent in the 1990s. The wage gap between the public and private sectors widened. Those with university degrees were rewarded more generously. There had also been an increase in the economic viability of education – its impact on improving material standing was becoming more and more apparent. However, the differences in socio-economic situation and occupational aspirations between genders seem to have led males and females to make different educational choices: women increase private investment in education more strongly compared to males. Those decisions may have been a response to the deterioration in their economic situation during the 1990s. Women were more affected than men by the unemployment that emerged as a result of economic transformation. Women's sense of economic empowerment has also been undermined by the shrinking network of childcare facilities for younger children, especially in smaller towns and villages. Although the economic situation in Poland has stabilised in recent years, there has been no significant change in the economic position of women in relation to men in the basic dimensions of occupational activity. This is reflected in higher female unemployment, lower average wages and more frequent labour market exits and returns. In addition to their structurally weaker position in the labour market, women are more pessimistic about their career prospects and have a greater fear of unemployment compared to men. On the basis of these observations, in Chapter 4 I hypothesized that the choice of more cognitively demanding and longer educational pathways is a form of insurance for women to compensate for their weaker position in the labour market.

Structural differences in the economic status of women and men are an important context for educational choices, but educational choices are not dictated solely by earnings or employability. In order to function smoothly in the micro-world of schooling, individuals need not only the relevant intellectual abilities to cope with the demands of the curriculum but also specific social capital. Higher educational attainment is fostered by positive attitudes towards education and the ability to adapt to school rules. The analyses in Chapter 5 show that female students outperform their male counterparts in at least some important areas of social and psychological functioning at school. For example, they find it easier to form social bonds with their environment, are less likely to engage in maladaptive behaviour, and have greater intrinsic motivation to fulfil their educational responsibilities. Boys, who on average score lower on these dimensions, have to make more effort to adapt to the school environment, which in turn leads to lower academic performance or, in the worst cases, dropping out of school.

Not all dimensions of the educational structure have shown such marked changes between the sexes as in access to higher education. The gender disparity in mathematics careers remain one of the last areas of education that has clearly been less affected by feminisation processes. In the United States, where the first methods for measuring educational attainment were developed, such unequal gender representation in mathematics was recognised as early as the 1970s, but this issue has also been much debated in recent years as the demand for high-level mathematical skills in the technology industry has increased. Why are women still more likely than men to opt out of careers in this field? What are the factors that lead to their under-representation in math-heavy majors? What makes them less enthusiastic about the economic incentives offered in mathematically skilled professions? The answer to these questions is the second research objective of this work, in addition to the analysis of differences in the educational attainment of men and women.

It will come as no surprise to social researchers that the reasons for different attitudes of male and female students towards mathematics are diverse and varied. Older hypotheses, developed at a time when educational choices were mainly explained through the prism of achievement, suggested that the lower proportion of women in mathematics-related fields was the result of their lower mathematical skills. This conclusion has been challenged several times since then. Developement of the large-scale abilities assesstment programmes played a major part in questioning the role of skill in gender gap in mathematics. International studies conducted at the beginning of the 21st century also in Poland, such as TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment), have shown that gender average in mathematical reasoning is small between male and female students and cannot be considered the main reason for women dropping out of mathematics-oriented education pathways. My analyses lead to a similar conclusion. A comparison of the results of mathematics tests – both at high and low levels of schooling – shows that the average differences in results between the genders are relatively small and more pronounced in the group of high-ability students. Bearing in mind, however, that it is not only test results that influence decisions about a career in mathematics, a separate chapter describes students' attitudes towards the subject. I suggest that a confidence in mathematical abilities and a belief in the purpose of developing skills in this area may prevail in the choice of educational or career path. These are addressed in Chapter 7, which is devoted to subjective perceptions of mathematical competence and anxiety in this area.

I explain the gender gap in mathematics from a broad perspective. My point is that mathematics is only one of a number of subjects that are available to students on the school "menu". Especially at the upper level of schooling, more and more subjects are competing for students' attention and maths becoming just one of many choices. The existence of attractive alternatives can determine whether it becomes the "main course" or a "starter". Discouragement from mathematics can be particularly strong where students have good grades in other subjects, where mastery of their knowledge is easy and rewarding, and where their successes have the approval of others. I formulate a hypothesis that one of the reasons why fewer women study mathematics is not that they don't like it, but that they outperform men in other areas such as the ability to understand and process a written text. The results show that female students are significantly better than male students in this area. Reading comprehension, being able to construct an argument based on what they've read, or reconstructing psychological portraits of literary characters, all give a sense of girls' high linguistic competence. This self-confidence, in turn, opens up a door through which they can step out of the world of mathematics at any time.

If we use the concept of relative advantages to understand where the greater representation of males in the mathematics-related sciences comes from, it can be seen that the spectrum of their choices is somewhat different from that of the female students. On average, some males are excluded from fields of requiring complex linguistic skills because of poorer reading skills and a consistent reluctance to develop them. Solving mathematical tasks does not require tedious deconstruction of the figurative text, interpretation of the mental states of literary characters and analysing the author's means of expression. Mathematics, especially in the higher grades, mainly involves communicating using signs and symbols. Those with poor reading skills (and males predominate in this category) may be attracted to mathematics not necessarily because they are interested in the subject, but because they have relatively fewer opportunities for success in other areas. This hypothesis will be the subject of further discussion in Chapter 6 on test scores and school examinations of male and female students.

The noticeable gender differences in the willingness to pursue education in mathematics-related fields may be due to popular beliefs about the aptitude for learning mathematics. There is a widespread belief that males have "scientific" minds, and this narrative of their natural superiority in such type of reasoning is reproduced with varying degrees of intensity in subsequent generations. Chapter eight explains how such socialisation patterns, transmitted at school and at home (often not explicitly, but in the form of subtle signals, unobtrusive suggestions, or small hints), can influence the educational trajectories of male and female.

Gender differences in education are analysed from a social perspective not only in chapter eight – this way of interpreting the phenomena dominates the work. To explain the issue I have also drawn on research in economics, psychology, and history. However, considerations of gender and education do not go beyond the social sciences. In particular, the once prominent, but now somewhat fading, debate between those favouring "biological" explanations and those favouring the role of socialisation factors in influencing differences in educational attainment between women and men has not been addressed. I decided to skip interpretation of the gender gap in in education through the lenses of genes, hormonal and neurological apparatus because, despite the fact that the number of research on this subject in growing steadily in recent years, it is not enough to formulate reliable conclusions. Also, such approach needs different methodological and theoretical background than offered in social sciences.

In addition to the synthesis of existing literature, I used various sources of data to draw conclusions about the educational pathways of women and men. These include international large assessment studies such as PISA, TIMSS, and PIRLS. They provide up-to-date information on the skill levels of students and their attitudes towards a range of issues, and are carried out at important stages in the school education process. The TIMSS study involves students in the fourth year of school, which in the Polish education system marks the end of early childhood and the beginning of more advanced learning. PISA focuses on students aged 15, who are about to decide on their future educational career. Analysing the attitudes of students at different stages of education is crucial for understanding the evolution of their attitudes towards education and mathematics.

The second source used was official and administrative records, including information published by Statistics Poland (GUS) and results obtained from Polish Central Examination Board. This type of material is exhaustive – by definition, it covers the whole student population, unlike surveys based on samples. Census data also allows to go back to a time before data on education were collected using surveys. However, the presentation of the dynamics of a particular phenomenon from the perspective of a long and uninterrupted period of time was only possible in a few cases. This is a limitation due to changes in the way GUS classifies and aggregates data into larger categories, the introduction of new publication standards, and reforms in the education system. For these reasons, among others, it has not been possible, for example, to compare the proportions of women and men who graduated in engineering and technical subjects a few decades ago and today.

Literature review is another important source of information that has contributed to a better understanding of the gender gap in education, but it is not without its limitations. For some time now, the academic community has been aware of the problem of selection in the publication of research. Studies which confirm that a particular phenomenon exists, or which show that differences exist between the categories analysed, are more likely to be published than those which do not show that such relationships exist. With this in mind, I reviewed the literature and, where possible, used meta-analyses, which synthesise research findings from a number of articles.

The combination of different sources of information – surveys, and official data with a review of the existing body of knowledge (despite the limitations mentioned above) – has made it possible to obtain a relatively comprehensive picture of the differences that are emerging between women and men in the Polish education system.

It is also worth noting that the data I used approach gender in a traditional manner, differentiating between two categories: female and male. Although the existence of a gender binary genders has been under scrutiny in social sciences in recent years, majority of large, representative surveys routinely offered respondents two separate categories: women and men.

The conclusions of this work are consistent with research findings from other countries in recent years. This may suggests at least some of the mechanisms behind differences in women's and men's educational trajectories are relatively universal. They influence individual educational decisions in a similar way, despite differences in the level of economic development, women's social status, or the organisation of the education system. The purpose of this book is to describe these mechanisms with reference to specific social, historical, and institutional factors in Polish society. Each generation described in this book lived in a different macro-structural social, political, and economic system. Whether they liked it or not, these systems played a role in shaping their educational pathways. The dramatic events at the turn of the 20th century, the formation of the new order after the World War II and the emergence and gradual stabilisation of capitalism determined the educational decisions of Polish women and men. In such circumstances, women and men spent a short but highly influential period of their youth thinking about which school to choose, calculating how long their education should last, and sometimes questioning the point of educating. Over the past few decades in Poland, these dilemmas have been resolved in the minds and hearts of millions of students and their parents. This book presents the results of these choices.

1

Getting a foot in the door: women entering education

There is no need to go very far back in history to see that universal access to education is a relatively new privilege of Western societies. On the one hand, the 19th century was a time of civilisational breakthroughs in science and the arts while, on the other hand, it was a period of deepening social inequalities. The ability to read and write was reserved for the social elite. In Europe, the level of literacy differed depending on regional historical conditions and individual characteristics (such as position in the social hierarchy). Compared to the Western countries, the situation in the Polish lands was unfavourable. The scale of illiteracy was particularly high in the Congress Kingdom of Poland (Russian Partition[1]), where it reached 70–80% of the population in the second half of the 19th century. In the mid-19th century, 40–50% of newlyweds and witnesses in Warsaw signed marriage certificates with the x-mark (Kowalska-Glikman, 1972). Other sources indicate that in comparison with the 28% of illiterate Belgians, 17% of Irish, and 6% of French (Miąso, 1981; Ihnatowicz, 2005), the difference was striking. A better situation in this respect was in Galicia and in the Prussian Partition, which may be linked with specific education policies.

Individual differences based on gender or social group overlapped with different educational policies in the Polish lands after the Partitions. In Galicia, universal education for children between the ages of 6 and 13 was compulsory from 1873, and parents were fined if their children did not attend school. Although educational authorities did not enforce this law very strictly, enrolment rates increased, with the percentage of children attending daily school reaching 63% in 1890 and 72% less than a decade later (Pilat, 1900). This acceleration may have been linked to Galicia's acquisition of autonomy, thanks to which Polish became the language of instruction in schools from the second half of the 19th century.

The network of primary schools in the territory of the Congress Kingdom of Poland underwent significant changes. In the second half of the 19th century, the development of educational institutions was too slow to meet the educational needs of a rapidly growing urban population, especially those cities aspiring to become industrial and cultural centres. A large wave of rural migrants flowed into Warsaw and Łódź but the number of school places increased at a disproportionately slower rate. The slow growth of educational institutions mostly was the result of the tsar's anti-education policy. In the 1820s, the number

[1] The Partitions of Poland were three partitions of the Polish–Lithuanian Commonwealth that took place toward the end of the 18th century and ended the existence of the state, resulting in the elimination of sovereign Poland and Lithuania for 123 years. The partitions were conducted by the Habsburg monarchy, the Kingdom of Prussia, and the Russian Empire [more information: tinyurl.com/4pmahpc6].

of primary schools in the Congress Kingdom of Poland fell by 40%, while the population increased by 600,000 (Gerber, 1960).

In addition to geographical and political conditions, gender was a strong predictor of the ability to read and write. It is worth noting that having both of these skills combined did not become typical until the mid-20th century. The fact that these skills were reported separately in historical censuses is evidence of their varying importance. For example, in Galicia (Austrian Partition) in 1890, just over 27% of males could read and write, 8% could only read, while 65% could neither read nor write. As for females 18% could read and write, only 10% could read and 72% could neither read nor write (Pilat, 1990, p. 4). In the city of Cracow itself, the differences were slightly less marked, but still unfavourable for women. At the turn of the 20th century, 74 out of every 100 men living in the city were able to read, compared with 67 women (Pilat, 1900). Data from documents drawn up in Cracow parishes indicated that men were 2.5 times more likely to sign a marriage certificate than women (an indicator of literacy), (Ogórek, 2018). However, these differences diminished within the younger generations: at the turn of the 20th century in Galicia, among the population under 20 years of age, already about 17% of women and 21% of men could read and write (Pilat, 1898; 1900). It must be admitted that the illiteracy and partial illiteracy of the Galician population was relatively high compared to other regions of the Austrian part of the Austro-Hungarian Empire. On average, in all regions of this part of Europe, 68% of men and 62% of women could read and write (Pilat, 1900). In general, low levels of school enrolment favoured higher levels of female illiteracy, while in regions with high levels of literacy, gender differences were small.

Higher levels of (total or partial) illiteracy among women and school girls were due to a number of factors, but it is doubtful that these were related to institutional exclusion at the primary school level. Rather, the gender differences in access to the lowest level of schooling mainly related to traditional gender roles, which assigned many domestic responsibilities to women, and to their generally low social status. For example in Austria girls were less likely to be enrolled in primary school (despite of equal formal access), but even those who were enrolled spent on average fewer days in education than boys. Tomas Cvrček (2020) showed that regardless of social status and distance from home (both of which were important barriers to access to education), girls spent about 5% less time in school than boys. A similar pattern has been observed in Polish lands. In the Kingdom of Poland in 1880, seven out of every 100 peasant girls attended primary school, compared to 15 boys (Miąso, 1992). In the villages around Suwałki in the 1870s, girls made up less than 20% of pupils, while in the town they made up 40% (Mędrzecki, 1992). These differences between boys and girls from working and rural families were largely related to the traditional social roles assigned to women. These roles emphasised their "usefulness" in carrying out daily tasks in the home, in the kitchen, or in caring for siblings. At the same time, the unwillingness of families to invest in educating their daughters was dictated by pragmatism and cold economic calculations. For most parents living in villages in the mid-19th century, it was clear that their daughter would not pursue a job requiring reading and writing. The nature of their future employment generally did not require them to become literate. Skills acquired in school were more useful for the sons, who were more likely to pursue careers involving reading and writing, including a career in the military (Apoznański, 1974).

The education of girls from lower classes usually ended at primary school or meagre initial grades. Daughters from wealthier and socially privileged families had higher aspirations and greater schooling opportunities. However, the problem was the lack of educational structures for girls who wanted to pursue higher education. The subsequent levels of education – secondary and tertiary – have become the subject of many years disputes between the authorities and supporters of women's emancipation. It seems that it was the question of access to secondary education that aroused particularly strong opposition in conservative social circles and among representatives of the authorities in the partitioners' lands.

What social processes led the way to the removal of systemic restrictions on women's access to secondary education? What was the chain of events that led to the erosion of the system that deprived them of the opportunity to obtain a matriculation cerificate (Polish: *matura*) certificate? What needed to happen for women to be entitled to obtain the same qualifications as men? Without a prior deconstruction of the arrangements that were simultaneously occurring in the political, economic, and social spheres, this revolutionary change could not have taken place.

1.1. Social factors of the growing educational aspirations of women

One of the reasons for the exclusion of girls from secondary education was the deep-rooted belief in traditional society that women and men differed in terms of temperament, cognitive abilities, and personality. The German scholar Karin Hausen (2010) has noted that the term "character of sexes", introduced into the public discourse of the 18th century society, served to reinforce, and arguably legitimize, existing social hierarchies. It was used to highlight the differences in psychological characteristics and physiological functions between men and women. The following century saw the consolidation of the idea of the two genders as categories endowed with specific characteristics. In 19th-century narratives, women's gentleness was contrasted with men's coarseness, their passivity and lack of competitiveness with men's activity, and their submissiveness with toughness. Women's sensitivity, their tendency to emotional introversion, modesty, perseverance, penchant for meticulous and routine work, vacillation, impatience, and impetuosity were contrasted with men's willingness to take risks and challenges, steadfastness, extroversion, courage, and explosiveness. The categorical belief in the different qualities of men and women shaped the imagination of people from all social strata, even though the differences in the standard of living and the burden of maternal and domestic duties on women differed dramatically between the aristocracy, the landed gentry, and the peasantry. Though peasant women were not mere accessories to their husbands at social gatherings, and those from wealthier classes did not have to dirty their hands with hard farm labour, yet they all played subordinate roles to their husbands and fathers.

The belief in inherent differences between the genders continued into the latter half of the 19th century, as women's participation in the workplace, politics, and education became a subject of debate in Europe, initially in hushed tones and then with increasing vehemence. It can be argued that the dominant mode of thinking about psychological differences between the genders at the time inhibited women's emerging emancipatory aspirations. According to prevailing social norms, only men possessed qualities that enabled them to hold public offices and take responsibility for the state and its institutions.

These narratives also influenced ideas about women's education. It was assumed that women were unable or unwilling to engage with complex scientific issues. The gender inequality in access to education was not definitive – women's educational opporunities were determined not only by social convention but also by family status. In the upper classes, the issue of education of girls was a family matter, and it was the parents' decision and wealth that determined whether their daughter would be educated. Home education, the dominant form of educating elite women until the mid-19th century, was limited to developing their "natural" talents, teaching them manners and preparing them for motherhood and family life. Progressive initiatives proposing more advanced learning content were seen as detrimental to the emotionality and sensitivity of women (Dobkowska, 2016; Hausen, 2010). It was argued that women could suffer "emotional damage" when exposed to the intellectual challenges above all of science. Areas of knowledge requiring spatial reasoning and deduction, such as mathematics, were generally not on the "agenda" of home education – nor were elite women in great need of it. Women from the upper classes received full economic support from their parents or family and, when they reached an appropriate age, by their husbands. The lack of need for a livelihood took the burden of learning practical skills off their shoulders. The separation of the elite women from the realm of work meant that, in their case, education, though lacking elements of real school education, was treated as a luxury supplement to their social roles rather than an investment in their future. The situation was different for men. Their closer ties to the labour market justified their right to benefit from a network of secondary schools and universities. But even they faced severe limitations. Unlike women's education, men's was not a "whim" but a means of achieving social status and building a social network. But even they faced severe limitations. Educational opportunities depended heavily on social class and the economic situation of the family.

Girls from lower social classes faced different obstacles compared to girls from lower social strata. Hiring private tutors or paying for a daughter to go to boarding school was beyond the means of a significant fraction of society. Women from poorer social groups began their adult lives in paid employment either with no prior education or with episodic education in a public school. There were sharp divisions between women from different social classes, based, as in the discourse on gender differences, on their "natural" needs and dispositions. Women's magazines published in the mid-19th century emphasised that "simple women", in contrast to "ladies", needed less rest and had innate ability to perform hard physical labour. They also pointed to the lower moral standards of the people from farmer and worker backgrounds (Poniat, 2014). By highlighting the distinctiveness, or sometimes their superiority, females from the elite constructed their social status not only in opposition to men but also to women from lower social classes.

Despite the persistence of traditional gender roles in the mid-19th century, the idea of educating women in the same fashion as men was gaining ground in European intellectual circles. The process of women's emancipation was facilitated by the growth of the intelligentsia, who possessed intellectual and social skills that allowed them to articulate and argue for the need to educate women, giving the issue the prominence it deserved. The press in the second half of the 19th century called for establishing a separate route to secondary education for women, for curriculum reform, and for raising the standards of teacher training. Women's rights activists sought to create an education whose scope would not be limited to lessons in housekeeping, calligraphy, and manners (Kolbuszewska, 2017) but would enable the acquisition of knowledge in various fields of learning, provided by professional teachers according to standardised curricula, and in a process supervised by central bodies. The first step in this revolution was the granting of women's access to *matura* and university examinations and participation on an equal footing with men. The demands of female's education supporters were not greeted with enthusiasm by the opponents of women's emancipation, who feared that women would not only enter the universities but would also take up positions in the courts, chancelleries, offices, and doctors' surgeries, i.e., areas that had been reserved for men.

1.1.1. Deconstruction of the traditional social system and the growing role of education

The erosion of the traditional social hierarchies acelerated the emergence of new intellectual trends. The crisis in agriculture and the process of peasant emancipation weakened the position of the gentry who formed a vital force in maintaining social order. The cycle of inheritance of estates and family capital, through which younger generations of men had access to capital and women had access to an economically secure future, was thus undermined (Hulewicz, 1939). The loss of land, estates, and privileges led to the political and social marginalisation of this class, forcing many of its members into urban employment. From the 1830s, members of the gentry flocked to the medical and clerical professions. They also sought employment as postal and railway workers. The entry qualifications for occupations attracted to the the newly formed intelligentsia differed, but most of the jobs was increasingly dependent on formal education (Smoczyński and Zarycki, 2017). There was also a strong incentive to gain a degree; there was a direct financial inducement to acquire professional qualifications for white-collar jobs in administration, education, health care, offices, and bureaus. For example, university graduates earned more than other employees of the Warsaw-Vienna Railway (Rożenowa, 1968) and senior civil servants were paid three or four times more than employees at the lowest levels of the organisational structure (Homola-Skąpska, 1972).

It was not only men who faced new challenges when the social status of the gentry changed. According to Jan Hulewicz (1939), the prospect of the economic degradation of women from the landed gentry in the mid-19th century was one of the reasons for the growing acceptance of the demand for their education. Deprived of dowries, school-related abilities and skills, and experience in shaping their own careers, women were more vulnerable than men to the adverse effects of changing agrarian relations. This was particularly felt by members of the petty and middle gentry, who tried to make a living using the skills of a well-bred lady (playing the piano, speaking foreign languages, embroidering, and dancing). Compared to men women encountered additional social opposition. The attitude to professional work among women from the intelligentsia or the poorer landed classes was ambivalent. There was a recognition of the need for their professional activation but at the same time, there was a repression of this need, which was seen as a last resort, acceptable only in cases of loss of economic stability after the death of their husbands or when they had no prospects of a lucrative marriage. Anna Żarnowska (2000) wrote that this conflict created psychological tension among the elite, which was dealt with by rationalising the work done by upper--class women: working and earning was perceived as a sacrifice or dedication to support a struggling family (Żarnowska, 1992). Such an approach made it easier to accept that a woman could be gainfully employed as a lacemaker, embroiderer, governess, or typist. In the inter-war period, when the number of employed women from upper social classes increased, the belief that work was an unpleasant necessity rather than a means of economic and social emancipation was still alive. Even later, it was only in the most liberal circles of society that the realisation of women's ambitions through work was accepted.

The acceptance of the progressive idea was facilitated by the introduction of the capitalist employment relationship into the whole of the economy, including the agricultural sector (Ihnatowicz, 2005). The organisation of work was modernised, workers were offered fixed wages, and working hours were regulated. In addition, companies and factories needed skilled administrative staff to manage work. Such changes forced middle-income families to rethink how they wanted to educate their children. Sons lost their preferential access to education, and some parents agreed to pay for their daughters to be educated, even if the consequences of this investment remained uncertain. As Anna Żarnowska (2000) noted, despite the fact that at the beginning of the 20th century completing secondary education did not guarantee employment or reproduction of social status, the cost of education was accepted because children schooling became an emblem that distinguished the families of the intelligentsia from other groups of city dwellers.

1.1.2. Importance of women's gainful employment

By the end of the 19th century, almost the entire population of the Polish lands was working for a living without formal schooling. This was more the case for women than for men, as the predominant number of female activities in farm in the 19th century did not require formal qualifications. The first wave of migrants who increasingly moved from the countryside to the cities in search of a better life in the 19th century also lacked education. As industrial development in Polish lands was slower than in Western Europe, they were initially often employed as domestic servants (Poniat, 2014). Until the first half of the 19th century, this occupation dominated the economically active urban population, clearly outnumbering labourers (people employed for simple tasks), shoemakers, and tailors. The domestic servants profession, which was still gender-balanced in the first decades of the 19th century, gradually became feminised, and eventually female-dominated at the end of the century. The modernising economy offered more employment opportunities, higher wages, and more transparent working conditions. However, women remained on the margins of these changes due to limited opportunities to gain employment in factories and companies. Driven by industrial development, the gender segmentation of employment meant that as late as the end of the 19th century, half of all women in the labour force were still working as domestic workers.

The number of employed women grew faster than the structure of their occupations. This process was particularly rapid in large cities. Analysis by Lidia Zyblikiewicz (2015) shows that in Cracow, between 1869 and 1890, the share of economically active women increased from 16.5% to almost 39%, and this number becomes even higher when younger age groups are included. By the end of the 19th century, almost two-thirds of women under 29 in Cracow were employed. The increase of female workforce partly contributed to the erosion of the traditional social roles, including the one that obliged women living in the "Age of Steam and Electricity" to stop working when getting married. This expectaion was shared by the working-class families and the intelligentsia, who differed on many issues of worldview, were in agreement on this point. The only difference was in the justification for the reluctance of married women to take up gainful employment. Among the workers, this attitude was the product of a particular strain of authoritarian traditionalism that gave men a monopoly on breadwinning. Among the more affluent social classes, employment of married women was interpreted by those around as a token of moral and economic degradation of the family. However, the reasons for keeping married women away from paid employment might have been of a more pragmatic nature. The inclusion of married women in the labour market meant that both employers and individual households had to deal with the problem of caring for young children. In the absence of a revision of domestic responsibilities shared by husband and wife, and with no system of care for young children, mothers were deprived of the opportunity to stay in the labour market for several years. However, partly due to the economic pressures, this norm was becoming gradually liberalised. In the 1870s, one in four married women in Cracow worked, and two decades later, one in three (Zyblikiewicz, 2015).

There was also a (not so dynamic) change in the structure of women's employment. In Galicia, until the end of the 19th century, they were most often employed in the textile and food industries, where they performed duties similar to the ones performed in their households. Women dominated these industries, partly due to stereotypes about their manual dexterity, diligence, and meticulousness (Zyblikiewicz, 2015). At the same time women increased participation in sectors that required certification of skills, such as health care, trade, and education. Work in public administration and offices became increasingly popular among women as well. By the turn of the 20th century, the number of women employed in the sector had increased 20-fold (Kozak, 2019), but in absolute terms, there were still relatively few women. Lidia Zyblikiewicz (2015) reports that in 1880, out of 12,000 economically active women in Cracow, only 125 could be classified as clerical and administrative workers. In the following decades, the feminisation of this sector continued. However, women were most likely to be employed in simple clerical jobs. One of the factors that influenced the increase in the number of women in public administration was the increasing popularity of the office typewriter into the office. Not only did this device significantly increase the efficiency of clerical workers, but as Meta Zimmeck (1995) points out, it also introduced a new definition of gender stratification. Analysing the influx of women into the British civil service, Zimmeck argued that the creative and more responsible part of office work was assigned to men, while the simpler routine tasks, requiring mainly typing skills, were given to women. Furthemore, based on an analysis of press materials, Agnieszka Janiak-Jasińska (2014) found that female typists were required by employers to be conscientious, skilful, and highly committed, while at the same time, they should have low financial expectations. They also had to demonstrate knowledge of up to three foreign languages (men – only two) when applying for the job of an accountant.

Gender occupational segregation was accompanied by wage inequalities. In the Austrian part of the Austro-Hungarian Monarchy at the end of the 19th century, men who could read and write were paid on average 20% more than women with the same skills (Cvrček, 2020). The gender pay gap, irrespective of skills, also existed in inter-war Poland. Tadeusz Bartnicki and Tadeusz Czajkowski (1936) analysed data from the Zakład Ubezpieczeń Pracowników Umysłowych [White-Collar Employees Insurance Institution] in Warsaw. They found that in 1930, women earned less than men, regardless of their level of education. Among white-collar workers, women with primary education were paid 74% less than men, those with secondary education 63% less, and those with tertiary education 54% less. The gender pay gap diminished at higher grades, but remained high even between male and female graduates. The gender pay gap was also evident when the educational profile was taken into account. In 1933, the highest inequality was found among graduates in technical fields – female graduates in this profile earned on average 42% of the amount paid to men.

Graduates in the technical profile earned more than graduates in other fields (Bartnicki and Czajkowski, 1936). Women also tended to be paid less for manual labour. In this case, the criterion of physical strength was an additional factor undermining women's usefulness in the eyes of employers. For example, in the Congress Kingdom of Poland at the end of the 19th century, female wages were even 50% lower compared to men working in the same occupations (Żarnowska, 1992). At the turn of the 20th century, education was not the most important factor influencing wages (not broken down by gender). Skills, rather than qualifications, generally determined promotion in a factory or office.

1.1.3. Demographic changes in the early 20th century

Changes in individual aspirations and the growth of empowerment have an impact on reproductive decisions of societies living at the turn of the 19th and 20th centuries. A systematic decline in fertility is evidenced in historic demographic studies covering the inter-war Poland and even earlier periods. Bartosz Ogórek (2015) found that in 1927, the total fertility rate in the Polish lands was 4.4, and only four years later it dropped to 3.5. This decline was particularly pronounced among women living in urban centres. In the 1930s, when the fertility rate for female residents of Cracow was 1.4 and that of Warsaw 1.28, rural women gave birth to an average of 4.1 children. However, the declining trend did not miss the countryside, it only appeared with some delay, e.g., in rural areas of Rzeszów Province in 1855–1880 the fertility rate was over 6 and in the early 20th century it was 4 (Ogórek, 2015). This trend has been linked with the increasing mobility and the availability of rail and road networks, which intensified human contact and consequently the flow of ideas and life styles. The countryside imported patterns from the urban centres. The rate of transmission was accelerated by the migration of young rural people to the cities, most of whom did not yet have family responsibilities. These people brought new, generally less traditional behavioural patterns with them when they returned to their farms.

The decline in the birth rate meant that women, regardless of social status and personal life situation, were freed from the cycle of constantly occuring, not always planned pregnancy, childbirth, and recovery. This may also suggest that the younger generations had a little more freedom to shape their own careers at school and in the workplace. Thanks to more controlled reproduction, women were able to stay longer in the education system, return to the labour market more quickly and to reduce the period of unemployment. However, this phenomenon worried inter-war Polish demographers, who linked lower birthrate with increasing female participation in educational and labour market

(Gawin, 2000). Such opinions exacerbated the social tensions associated with the emancipation of women.

1.1.4. Origins of institutional framework for secondary education

In Poland, the demand for girls to be admitted to secondary school – and in the longer term to university – on an equal terms with boys coincides with a time of profound political and economic instability, national insurrection, and economic transformation. The unpredictability of social and political conditions, coupled with the lack of school infrastructure and financial costs, make the organisation of a secondary school for females a challegning endavour. Resources necessary to educate girls – infrastructure, rules governing the educational institutions, curricula, and professional teaching staff – had to be created from scratch. In the absence of adequate educational resources and, most importantly, long-term plans, the second half of the 19th century was marked by a series of short-term solutions, ephemeral experiments and half-hearted measures that were intended to address women's educational aspirations. This kind of initiatives were an alternative to the 19th-century model of education for upper-class girls at home or in private boarding schools. One of the criticisms of this form of education was the quality of the knowledge imparted. The "curricula" differed according to social class, but generally did not include science. Home education for the daughters of landowners was usually limited to reading and writing, religion and catechism, elementary mathematics and, to a lesser extent, history and home economics. The educational programme for the daughters of aristocrats and wealthy landowners was somewhat less focused on the everyday tasks of a housewife. Because of the role that women of the noble families were expected to play in their social circles, greater emphasis was placed on the learning of etiquette and the development of artistic skills. Social status also influenced the schooling opportunities of women educated at private boarding schools. For example the daughters of craftsmen or better paid workers were admitted to schools with the shortest, two- or three-year learning cycle, while the daughters of petty bourgeoisie and poorer landed gentry families could afford an education that lasted longer by one year. Boarding school education that lasted six years was intended for girls from upper social classes. Wealth affected not only the duration but also its quality. Parents had to make a greater financial investment in order for their daughters to have better teachers and a broader curriculum (Pachucka, 1958).

The educational opportunities of girls from peasant and working-class families was significanly lower. They also differed from their peers from the upper classes in terms of the function they performed in the home.

From early childhood, girls were expected to carry out domestic duties and daily activities crucial to the survival of the entire family, including caring for siblings. In addition, girls from poorer families, particularly living in rural areas, were exposed to an underdeveloped school network. For example throughout the 19th century in the Austrian part of the Austro-Hungarian Empire, the proportion of female pupils in public primary schools was lower than that of male pupils, but the magnitude of this difference depended on the size of school facilities (Cvrček, 2020). In Austrian provinces, including Galicia, the gender gap was larger when access to schools was relatively sparse and narrowed in areas with a dense school network. In the 1820s, the gender gap was around 11% in favour of boys, while from the 1870s until the World War I, when the number of public educational institutions increased, it fell to 1–2%. However, it is difficult to assess to what extent this change was only caused by increased access to schools, and in what way increasingly favorable attitudes towards the education of daughters.

1.2. Access of women to secondary education in the Polish lands in the 19th century and at the beginning of the 20th century

The idea of educating women was controversial not only because it meant breaking with 19th-century social norms shared by much of society. It also involved the need to create an education system that was both progressive enough to satisfy the educational aspirations of young girls from the upper classes and their families and efficient enough to gain the legitimacy of the wealthy classes who would agree to finance their daughters' education for several years. Above all, the idea of secondary education for girls had to become a social institution: a stable and organised structure with a specific purpose, its own staff, curriculum, and governing bodies. Meeting those conditions was hardly possible in the circumstances of the latter half of the 19th century. Furthermore, as the Polish lands were partitioned until the World War I, each land had its own way of dealing with girls' education. As a result, there could not have been any school policies or curricula uniform for all Polish lands.

1.2.1. Education in the shadow of the Tsarist regime

In the Russian partition, the direction and method of women's education after primary school was strongly influenced by the political situation. The Chamber of Education – an institution responsible for educational activities during the Duchy of Warsaw – was sceptical about the concept of educating girls in boarding and private schools. It urged that education should be provided in the family home. In official narration it was argued that boarding and private schools provided low quality education, while in fact, Polish officials operating under Russian partition worried that such school fail to provide proper patriotic education. Concerns of this kind became even more acute after the third partition of Poland. It was believed that the boarding schools, often run by foreigners, had no place for proper education in this area and that mothers supporting or conducting home education would be better able to cope with such a task. Women were expected to participate in the patriotic education of the younger generation and to take a more active part in civic affairs (Winiarz, 1995). Their involvement in the role of conspirators, couriers, and initiators of philanthropic campaigns (especially during the January Uprising) became an important argument in late 19th-century debates on gender equality.

This was also the role of out-of-home education, which was to form attitudes rather than educate. The crowning achievement of legal regulations concerning the operation of boarding and private schools was the *Regulament pensji i szkół płci żeńskich* [Regulation on Boarding Schools and Schools for Girls], issued in 1810. It was the first normative act introduced in Polish lands, devoted entirely to the education of girls. Among other things, the document specified the duration of education in both types of institutions, introduced a general minimum curriculum framework, defined the form of supervision of the operation of the institutions, and regulated who was to teach and what was to be taught.

These regulations signalled only a partial change in the way of thinking about the education of women. Katarzyna Dormus (2015) points out that although the normative act reflected increasing concerns and importance of secondary education for girls, the train of thought did not change much. Advocates of equal education for women and men pointed out that the document gave a higher status to education at home, with boarding or secondary school as a possible alternative. The authors of the regulation were criticised for focusing the education of female students in such institutions on religious topics and practical skills for everyday life, even though modern languages, arithmetic, history, and science were also part of the curriculum. The most important thing is, that despite its considerable scope, the curriculum was different from that of the secondary schools for boys. Male students also acquired knowledge in the areas that were most necessary for everyday life, but in their case, this meant the study of foreign languages (including the classical ones), science, and technical subjects. These differences were justified on practical grounds. The official regulations of boys' schools stated that the mission of these institutions was to prepare students for university and for important social roles and functions in the government. In contrast, the rules and regulations of girls' boarding schools made it clear that education was to prepare women for their roles as wives and mothers, not for the "vain display of extensive and profound knowledge" (Winiarz, 2002, p. 318). However, the most significant curricular difference between boys' and girls' schools was not knowledge of food prices or effective methods of managing servants, but learning Latin (Dormus, 2016). In the years that followed, the absence of this subject in the canon of women's education seriously hindered their access to university.

The Board of Inspectors of Female Boarding and Private Schools (established by a document dated 1810) aimed to organise the system of education, but this was not followed by enforcement powers. The power of on-the-spot inspections was generally limited to reporting irregularities in individual schools, without real effect on quality of their operation. Negligence reported in some boarding schools raised concerns about the future of upper-class female students. These worries were compounded by the prospect of the deteriorating economic position of the landed gentry. For some young maidens, this meant losing their dowry and diminished chances of marrying a well-born man. Historians suggest that the fear that dispossessed upper-class women would become a part of the social fabric prompted government educational institutions to work further on improving the quality of schooling (Winiarz, 2002). This issue became more pressing as successive reports issued by the Boarding and Private Schools Inspectorate continued to reveal gaps and shortcomings in the way these schools for girls were managed. The question of girls' education became so important that it was discussed at the Sejm of the Congress Kingdom of Poland in 1818 and 1820. Further guidelines were issued to increase the quality of boarding schools, including the appropriate teacher training. In 1825, in response to the shortage of teachers, the Governess School was established in Warsaw. It was a state institution for the training of female teachers offering a one-year training in religion, pedagogy, and teaching methods (Dormus, 2016; Winiarz, 2002). Initially, thanks to its teaching staff and comprehensive curriculum, the school enjoyed an excellent reputation among the intelligentsia. However, it did not survive the fall of the November Uprising (1830–1831). As a result of the post-uprising Russian repressions, the schools for girls became restricted and subjected to a process of Russification. Teaching science subjects was significantly limited, while other domains, such as geography and history, were saturated with ideological, pro-Russian content and were taught in Russian. Parents who paid for their daughters' education did not accept these changes, and the school irrevocably lost its reputation and disappeared from Warsaw for many years.

The idea of preparing teachers and educate girls based on higher standards was ceased by the ideological and political ambitions of tsarist authorities, which sought to strengthen the role of state schools and devalue private schools for girls. One example of these efforts was the establishment of the State Boarding School in Warsaw in the 1850s. Because of the high tuition fees, the school enrolled girls from the aristocracy and daughters of government officials. However, it soon became clear that the number of applicants from the gentry and the families of civil servants exceeded the number of places available at the school. The desire to educate the daughters of less well-off families also increased. One way of attracting women from different social backgrounds to education, and at the same time allowing the Russification policy to penetrate new communities, was the establishment of more state-run girls' schools, with lower social and financial criteria for access to education. The fivefold reduction in financial requirements had a mobilising effect on the aspirations of less affluent elite groups, and in response to increased interest, the authorities opened school branches outside of Warsaw.

Female graduates of state schools were formally qualified to work as governesses (Schiller, 1994), but the most important issue – access to the secondary school leaving certificate – was still unresolved. In the state schools for girls, the acquisition of the matriculation certificate was only possible in an extramural mode. Girls who wanted to take the exam needed to individually supplement their knowledge according to the standards of secondary school for boys. This was particularly the case in the field of natural sciences, where girls' schools had limited curricula. The standardisation and expansion of the mathematics and physics curricula in girls' and boys' schools did not take place until the period before the World War I (Mauersberg, 1980).

The Tsarist regime's control over girls' education declined in the mid--19th century. The education reform, prepared on the initiative of Aleksander Wielopolski and promulgated shortly before the outbreak of the January Uprising, opened up a somewhat wider scope for the development of private education. This led to further changes in the structure of women's education. Of the eight state girls' schools in the Congress Kingdom of Poland, two were to be retained and women were to be educated mainly in private and boarding schools. Such institutions were established voluntarily, but not for long, because after the outbreak of the January Uprising, the tsarist authorities again restricted the possibilities of educating women outside state control (Miąso, 1992; Winiarz, 1995). State-run lower secondary schools for girls were established in large cities. Graduation from these schools qualified women to become home teachers, but, worldview aside, only wealthy families could afford to educate their daughters there. Private education was less expensive, but the number of such schools was drastically reduced. Moreover, they lost their ability to educate in patriotic spirit due to the increased scope of tsarist control (Staszyński, 1968).

The following two decades, i.e., the early 20th century, were marked by a further slowing down of initiatives to educate girls. Female residents of the Congress Kingdom of Poland could only obtain a secondary school certificate externally at a Russian male secondary school, and after 1905, before a Warsaw school district committee. This route was taken only by the most talented, determined, and courageous women.

Progress in the admission of women to secondary education in the Congress Kingdom of Poland was relatively slow. Their educational opportunitines were overshadowed by tsarist state policy for most of the 19th century. In a period of nationalist uprisings and weakening and intensifying Russification tendencies, the creation of a stable environment conducive to the realisation of long-term school policies proved impossible. Despite these obstacles the idea of women's education, which had been initiated at the beginning of the 19th century, could not be forgotten. From then on, the educational aspirations of women's circles could no longer be silenced or ignored. This was demonstrated by the establishment of a clandestine educational institution in Warsaw called the Flying University (sometimes called the Women's University), which provided education for women who could not attend traditional universities.

1.2.2. Female graduates from upper secondary schools in Galicia

Secondary education for girls in Galicia developed under different institutional and political circumstances. As in the rest of Polish lands, women's circles in the region wanted to create a school that would offer a qualification equivalent to a boys' secondary school matriculation certificate. The authorities had consistently resisted these aspirations by applying ostensible measures in the area of curricula, the quality of education, and the professional qualifications gained by female secondary school graduates.

The education authorities followed the tried and tested policy of small steps. In 1871, the goverment opened the state teachers' training colleges (*seminarium*) for women, offering a four-year course preparing to teach in higher tiers of women's schools. However, because their curriculum was limited to superficial knowledge of social subjects, domestic work, and natural sciences, these institutions did not have the status of secondary schools. Their graduates were awarded a diploma, but it was not the equivalent of a matriculation and it did not allow them to enter university. The acquisition of a *matura* certificate was only possible after taking an examination at a secondary school for men, while women had to fulfil additional requirements and be approved by a special committee to do so (Dormus, 2016). Women's access to university education was, therefore, not completely closed, but there were major barriers.

Under pressure from many social circles, various initiatives for the development of identical educational pathways for both genders have been on and off the agenda over the years. More or less formalised initiatives have attempted to bridge the curricular differences. One example was the Pedagogical Society, which offered women the opportunity to acquire knowledge in fields to which they had limited access – such as anthropology, botany, geography, and nutrition (Dutkowa, 1995). The secondary faculty schools (*szkoły wydziałowe*), established in 1885, were more structured. Initially an extension of the folk high schools, in later years they constituted a separate educational level, and some took the form of grammar schools (*licea*). However, they did not constitute proper secondary schools, since the certificates awarded did not correspond to the matriculation certificate awarded by boys' grammar schools. The reason for this state of affairs lay in the differences in the curriculum. Girls' schools implemented traditional patterns of education for women instead of providing education in natural sciences and classical languages necessary for admission to a university (Dutkowa, 1995; Dormus, 2016).

The social status of female students in secondary schools varied to some extent, as did the organisational structure of these institutions. Secondary faculty schools were attended by students whose families could afford a shorter cycle of education as well as by those from more affluent families who wished to complete the full eight-year programme. For the former, a few years of additional education after primary school was associated with significant social upward compared to the position of their mostly illiterate mothers. Although the shorter education cycle did not entitle the daughters of laundresses and cooks to take up white-collar jobs, the exposure to girls from other social classes, like daughters of doctors and lawyers, further stimulated their educational and professional aspirations.

It is doubtful, however, whether the education provided by high schools lived up to the expectations of the upper classes. Renata Dutkowa (1995) points out that the curriculum of these schools allowed female graduates to get, at best, an inferior job in an enterprise or clerical position. Such a pathway prevented the intergenerational reproduction of social status and created the risk of moving down the social hierarchy. The unfulfilled aspirations of the women of the upper classes were all the more frustrating for them as they were aware of the better educational opportunities available in Western countries. The discontent among the families of Polish doctors, lawyers, and professors must have been exacerbated by the availability of the foreign press describing the entry of French, Swiss, or English women into higher education from the 1860s onwards. While this historic change was taking place at the universities of Paris and Geneva, in Galicia there was still a debate about how women should be educated at secondary school level. This was the subject of heated debate in the popular press of the time. Kazimiera Bujwidowa, a feminist activist, in response to the words of the Minister of Religion and Enlightenment, who insisted that women should perfect "true femininity" in the education process, wrote in the *Nowa Reforma* magazine [*New Reform*]: "I know that 'true manliness' is not taught in any boy's school, and as far as I can tell from experience, no man has ever complained of a lack of special preparation there" (Bujwidowa, 1902). She pointed out that the subjects taught in women's schools were deliberately tailored to cognitive structures that were described as "feminine". For example, women's history was taught in classes in history, drawing was taught alongside knitting and knowledge of chemistry and mathematics was reduced to content applicable to the household duties. Changes in stereotypes about women, and in particular a move away from the belief that they were cognitively and intellectually inferior to men, had to precede the overcoming of curricular constraints.

Those who rejected the notion that women were intellectually limited continued to press for a school structure that was equal in the curriculum to the men's secondary school (*gimnazjum*). In the 1870s, growing pressure of feminist circles led to the liberalisation of the establishment of private schools. The state authorities shifted the burden of organising and financing women's education to the upper classes, who were major beneficiaries of the postulated changes. This opportunity was seized by women's movement activists in Galicia. In 1896, on the initiative of Kazimiera Bujwidowa, the first girls' school in Cracow and Poland was founded. The National Board of Education symbolically downgraded its rank and instead of calling it a *gimnazjum* (a term traditionally connected with secondary schools for boys), the institution was given the name *szkoła gimnazjalna* (Dormus, 2016). Disregarding the label, thanks to the possibility to influence the curriculum, education activists expanded the scope of knowledge by "controversial" subjects, such as natural science and classical language, that were required for the matriculation examination. It was not until the 1890s that the Austrian authorities allowed women access to the examination, albeit under certain conditions. The opportunity was open to female students who met a number of formal requirements, mastered the required material (either on their own or with the help of private teachers), and applied to the National Board of Education for permission to take the examination. It is symbolic that even after meeting those requirements, women still had to sit the examination in a boys' secondary school and, unlike male students, could not exercise their right to be exempted from certain examinations if their school grades showed good mastery of the material (Dutkowa, 1995). The admission of women to matriculation examinations, even on unequal terms, was a turning point for the educational community and policy makers of the time. The first examination sessions with women were treated like a social event, almost of a state-level importance, with representatives of national education authorities, including the Minister of Education, observing the women taking the exams.

Interest in matriculation among the more girls from upper social classes increased with the success of the first female matriculation certificate holders, but the financial criterion effectively dampened the aspirations of the less affluent girls. This, of course, had consequences for the selection processes based on social background. Renata Dutkowa's (1995) analyses, based on data from three secondary schools in Cracow, showed that girls from intelligentsia were more likely to enroll and that the dominant group of female students were the daughters of lawyers, barristers, doctors, engineers, and civil servants. A smaller number of daughters of lower officials were educated in these institutions, and female students from working-class and peasant families were the least likely to benefit. The cost of education prevented the latter from attending grammar schools, which in any case did not guarantee professional and economic independence for women in white-collar professions. Female students from poorer classes were more likely to pursue teacher training colleges (*seminaria*), which provided a predictable career path. Studying in such schools offered a twofold advantage: firstly, it relieved them of having to pay for education, and secondly, it offered a more secure prospect of finding a teaching job.

Thanks to improvements in quality and the expansion of core curricula, the number of private secondary schools for women increased in the years that followed. In 1908, there were 1,413 girls studying in women's secondary schools in Galicia. This was quite a large number compared to 26 female students at the end of the 19th century, but extremely small compared to the number of male students: in the early years of the 20th century, there were 30,633 male students (Buzek, 1909). Even if all girls had taken the matriculation exam, the gender gap among university applicants would still have been significant.

1.3. Access to tertiary education for women in the Second Polish Republic

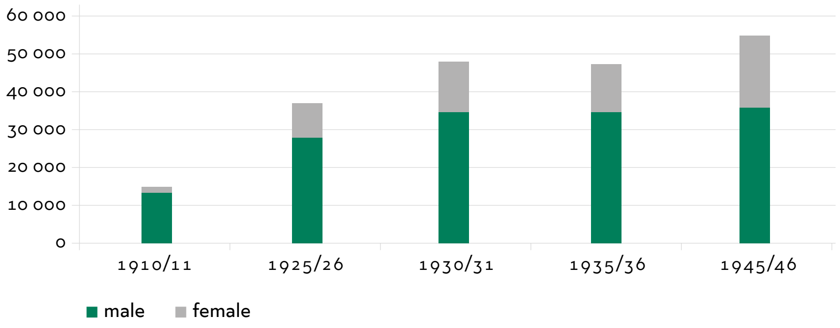
The degree of feminisation varied from university to university. The earliest opportunity for women to study was in Galicia, after a long process of concessions by the Austrian authorities. At the end of the 1870s, the Ministry of Education granted women permission to study as *hospitantes* (visitors), albeit neither their status nor their obligations, including admission rules and those relating to examination taking, were precisely defined. Individual decisions about admitting women to examinations and ultimately to graduation were left in the hands of the lecturers and university authorities. In the years that followed, the rules of study at the various faculties were gradually equalised. An important step was the decision in 1897 to allow women to study as regular students at the Faculty of Philosophy of the Jagiellonian University. Sometime later, they were also allowed to study at the Faculties of Medicine and Pharmacy. It was not until 1919, that women were allowed to study law (Urbańska, 2010).

At the University of Warsaw, the opportunity to study in all of the existing faculties came about with the rebirth of the university in 1915. Jerzy Halbersztadt (1996) suggests that the existing tradition of higher education in the area, including the "Women's University", led to the progressive decision to admit women to all faculties simultaneously. The lecturers of "Women's University" were used to the presence of women in the university halls and they also largely formed the staff of the University of Warsaw. But not everyone was enthusiastic about the presence of female students. Some academic and administrative staff had doubts about women's intellectual motivations for pursuing tertiary degree and about the career benefits resulting from completing higher education by women. Among other things, the opponents of female access to universities pointed to the burden of having children, which may lead females to withdraw from the labour market. Those views were not completely ungrounded. Women were less likely to complete their studies, and their decision to pursue an academic career often meant that they had to give up family life (Halberstadt, 1996, Perkowska, 1992; 1996). However, in the diaries left by the first generation of female students, one cannot find any mention of the open discrimination of females in universities or signs of alienation resulting from belonging to an unwelcome minority (Kolbuszewska, 2017). However, it may be asked, how many issues have been passed over in silence in the memories of the first female students. It cannot be ruled out that women, aware of their coming to the forefront of civilisational change, played down uncomfortable situations.

In the inter-war period, studies became part of the life plans of a growing number of young people entering adulthood. The experience of the trauma of armed conflict, combined with new lifestyles coming to Poland from Western Europe, influenced the way the young generation thought about its future. A growing number of women from the upper classes were taking university entry exams. In the ten years since this opportunity had been granted, the number of female students increased six-fold, while the number of male students slightly more than doubled over the same period. In 1910, women accounted for 10% of students, while in 1930 this number had risen to 28%. It is worth putting these figures in the context of the rates of access to education. It should be remembered that even taking into account such a considerable increase, the total number of students in the inter-war Poland was extremely small. In 1910, there were more than 15,000, and two decades later just over 40,000 students (GUS, 1932a). In a population of over six million young people recorded in the census of the early 1930s, students accounted for 8‰ of people aged 20 to 29. In the same year, 23% of people over the age of ten still could not read or write. Interestingly, despite the increasing number of school opportunities for girls a gender gap could still be observed. In the early 1930s, 15% of men and 28% of women were illiterate. Rural women continued to have much more limited access to even primary education than urban women. This was reflected in the following levels of illiteracy among these groups: 33% in rural areas and 15% in urban areas (GUS, 1939).

In the years that followed, the growth in the number of female students slowed, although it was still more intense than that of male students. Between 1910 and 1930, female enrolment increased ninefold, while male enrolment doubled. Because of their initial overrepresentation, men continued to outnumber women at universities, although this advantage gradually diminished. By the end of the 1930s, women made up almost a third of the student population. The University of Warsaw stood out in this context. Shortly before the outbreak of the World War II, at the University of Warsaw, the proportion of female students was over 40% (Majewski, 2016).

FIGURE 1.1. THE NUMBER OF MALE AND FEMALE STUDENTS BETWEEN 1910 AND 1946



Source: GUS, 1932b; 1937; 1947.

The freedom to choose a field of study was another major step towards equal access of males and females to universities. In the inter-war period, pharmacy and dentistry were the most popular faculties among female students. Unlike medicine, these faculties quickly became feminised. The proportion of women studying law and political science has also increased significantly (by almost 8 percentage points), which may be linked to the gradual liberalisation of women's access to legal professions.

TABLE 1.1. PERCENTAGE OF WOMEN IN SELECTED FIELDS OF STUDY IN THE ACADEMIC YEAR 1925/1926 AND 1935/1936

Field of study	Academic year	
	1925/1926	1935/1936
dentistry	83.5%	70.9%
pharmacy	53.9%	51.5%
philosophy	47.4%	54.4%
medicine	17.7%	21%
chemistry	14.8%	19.7%
architecture	12.7%	16.1%
law and political sciences	8.6%	16.4%
communications and engineering	1.2%	1.2%
mechanical and electrical engineering	1.1%	1.4%
percentage of women among students and unrolled students	25%	27%

Source: GUS, 1932b; 1937.

In contrast, the engineering majors (referred to in Table 1.1 as communications and engineering and as mechanical and electrical engineering) were attended almost exclusively by men. The exception was architecture, which attracted considerable interest from women. In the mid-1930s, 16% of women studied architecture. The under-representation of female students in engineering may also be explained by the fact that formal barriers to entry were removed somewhat later in technical colleges than in universities. Women were allowed to study at the Warsaw University of Technology from 1915 and at the Lviv University of Technology from 1918. However, they remained a distinct minority at both institutions until the outbreak of the World War II. They accounted for 7.9% of the total number of students at Warsaw University of Technology in the academic year 1937/38 and 5.5% at Lviv University of Technology in the inter-war period (Piłatowicz, 1989). Table 1.2 provides more detailed data on the proportion of women at both universities. At the Lviv University of Technology, there was considerable interest from women in the faculties of architecture and chemistry (more than in the corresponding faculties at the Warsaw University of Technology). However, at both universities, female students were in the minority.

TABLE 1.2. PERCENTAGE OF WOMEN AT THE LVIV UNIVERSITY OF TECHNOLOGY AND THE WARSAW UNIVERSITY OF TECHNOLOGY IN THE ACADEMIC YEAR 1935/1936

Faculty	Lviv University of Technology	Warsaw University of Technology
engineering	1.3%	1.1%
architecture	24%	10.5%
chemistry	33.2%	11.4%
electrical engineering	–	2.9%
mechanical engineering	0.9%	0.8%
percentage of women among students	4.2%	7.2%

Source: GUS, 1937.

It is worth noting that engineering were also less popular among men at this time than law and philosophy. In the academic year 1935/36, the faculties of communication and surveying, architecture, mechanical and electrical engineering, chemistry, mining, and metallurgy attracted 19% of all male students, while Law and Political Science had 34% (GUS, 1937).

In the inter-war period, the universal principle of granting the privilege of choosing a more selective educational path to those individuals who possessed social and cultural capital was still very much alive. The faculty of humanities at the University of Warsaw, which had no selection requirements other than a school-leaving certificate, attracted more students from working-class backgrounds and children of small entrepreneurs. Fields of study such as law, medicine, and pharmacy, which required passing an additional examination upon enrolment, were more often studied by young people from the more affluent intelligentsia, from the families of white-collar workers and representatives of the liberal professions (Majewski, 2016).

Family social status also affected daughters' educational opportunities more than sons'. Not all families could afford to pay for a girl's education for several years. It was riskier to invest in the education of daughters because they had poorer career prospects than men and were generally paid lower salaries, which might not compensate for the cost of their tertiary education. The deteriorating financial situation of families was probably one of the reasons why women dropped out of their studies more often than men. Piotr M. Majewski (2016) reports that throughout the inter-war period, 32% of enrolled male students graduated from the University of Warsaw, compared to 23% of female students. During this period, it took an average of seven years for women to complete their studies, compared with an average of five years for men. Among students at the University of Warsaw, it was also observed that women came from families that were better off than men. Female students who were not supported by their families, on the other hand, had to make their own financial ends meet. They tended to take lower-paid casual jobs than their male counterparts. Financial difficulties were one of the factors that influenced the fact that women were less likely than men to graduate from university throughout the inter-war period. Another was motherhood (not always planned) and the burdens associated with it.

1.4. Limited access to certain professions

The social changes of the inter-war period increased the demand for professionals in government departments and administrations offices, as well as for medical personnel. Universities became a recruitment channel for these jobs, and the candidates for specialists originated from the rising intelligentsia. The growing interest of people from this class in studying was one of the factors influencing the stricter selection procedures for faculties with higher social prestige. An additional factor influencing the selection for some fields of the study was gender. Women were more strongly scrutinised for admission, to medicine and pharmacy degrees. Universities in the mid-1930s admitted a greater percentage of men than women from among the applications submitted for studies. For example, for pharmacy 62% of male candidates and 27% of female candidates got accepted to the University of Warsaw, to the medical faculty – 32% and 26%, respectively (Wittlinowa, 1937). Greater selectivity towards women in these fields can also be seen in the data regarding subsequent years of the inter-war Poland (GUS, 1937). Relatively equal percentage of candidates were admitted to the humanities and mathematics and life sciences. It is debatable if there was an unequal selection in the case of hard sciences, because most faculties had only individual applications from women (Wittlinowa, 1937).

1.4.1. Legal professions

There is also no evidence for a greater exclusion of women at admission for law studies – in the mid-1930s Poland, admissions to these studies for a given gender were similar. However, existence of another type of selection may be evidenced by the fact that the number of women and men interested in taking up law studies: in 1935 more than five times as many men as women wanted to study law at Polish universities (Wittlinowa, 1937). It can be assumed that such gendered self-selection in law departments was driven partly by females' anticipation of marginalisation in male-dominated environments. Moreover, there were formal exclusions from some professions – the judiciary, for example, had a policy against the admission of women. Being a man has been one of the requirements for candidates for trainee judges, along with Polish citizenship, unblemished character, and relevant education. The issue of gender was so important that this condition was already mentioned in the first article of the Decree on Judicial Training of 8 II 1919 [Dekret o aplikacji sądowej z 8 lutego 1919 roku (Dz. Pr. P.P. 1919 nr 18 poz. 225)] even before the detailed description of the judge applicants duties. Although women were allowed to undergo judicial training, they were only allowed to do so as preparation for work as a lawyer or for employment outside the legal profession. They were not allowed to become judges until 1928 (Krzyżanowski, 2011).

Access to the bar was formally opened to women earlier (1918), but moral norms made it difficult to start and continue a barrister career. The decision on admission to the bar was left to the discretion of the authorities of the bar association who shared a conservative view on gender roles (Łysko, 2015) and were reluctant to extend the privileges of the profession to women. The growing number of female candidates put pressure on the community and, as a result, the number of female barristers grew steadily. According to Maria Stypułkowska (1994), in 1926 the Warsaw Bar Association registered one female barrister and 11 female trainee barristers, and in 1934 there were already 89 female barristers and 112 female trainee barristers, the latter numbers representing 5% of the bar and 16% of all trainee barristers.

The position of the Polish judiciary towards women was not unique under international comparison. Juliette Fette (2012), when analysing the monopolistic practices of the French elite, pointed out that the discourse used by those opposed to admitting women to the legal profession resembled that used during women's struggle to gain access to university. The alleged weakness of women's character and emotionality was contrasted with the challenging and complex working conditions in the courtroom. According to opponents of gender equality, men were better equipped to deal with these requirements. One of the criticisms of female legal candidates was that "personal charm" could help them win favourable decisions in the courtroom. The other reason for this attitude on the part of men was fear of serious competition from women, Fette (2012) argues. Systematic lobbying for legislation to close the professions and the formation of exclusive professional and social groups that worked in solidarity to maintain the *status quo* were manifestations of defence against this.

1.4.2. Women's work in education

Legislative practices restricting women's professional activities were not limited to legal and medical professions. An example of this, in relation to a profession that was already quite significantly feminized in the inter-war period, is the "Celibacy Law" (Law of 29 March 1926 on the Termination of the Teachers' Contract if She Marries [Ustawa z dnia 29 marca 1926 roku w sprawie rozwiązania stosunku służby nauczycielskiej wskutek zawarcia przez nauczycielkę związku małżeńskiego]), which was introduced in Silesia on the initiative of the Silesian Provincial Council. This document made it impossible for married women to take up or continue work as school teachers. Originally, the law covered only female teachers with short terms of service and without full professional certification, but in subsequent years neither of these factors protected them from losing their jobs after a change in marital status.

A detailed justification for the introduction of the ban on married female teachers was given at a session of the Silesian Parliament in 1926. Reference was made to the "weakness of character" of women. It was claimed that women did not have a "strong enough hand" to discipline young students. It was emphasised that their professional activity could lead to the collapse of the traditional family structure, in which the man looked after the household and the woman "indulged in work around the home and family" (Silesian Sejm Stenographic Report, 130th Session of the Silesian Sejm of 20 January 1926 and 134th Session of 29 March 1926). It was also emphasised that married women, i.e., expectant mothers, burdened the school budget by exercising their right to leave too often and that their absence made the organisation of school work more difficult. It is noteworthy that alongside the "arguments" pointing to women's alleged intellectual deficiencies or personal inadequacies, concerns were explicitly expressed about the economic threat they posed to men: "[...] in a year, two years at the most, hundreds of young males who will be leaving teacher training colleges will face unemployment. Considering this, it is difficult to be enthusiastic about giving a salary to two people in a family, while so many men, who by nature are destined to earn a living for their families, will remain unemployed" (130th sitting of the Silesian Sejm).

Many teachers and educators from different parts of Poland opposed the Silesian "Celibacy Law" rule. There were articles in specialist press pointing to the unconstitutionality of the document, and "double standard" in the assessment of women's professional work, depending on their personal life situation. It was pointed out that arguments concerning the preservation of traditional family order or the quality of women's lives did not arise when it came to female workers doing physically demanding, dirty work in factories, commerce, and agriculture (Gilmos-Nadgórska, 2000). However, opposition from progressive circles outside Silesia was not strong enough to stop the law being enforced. Even before the decree was issued in 1926, 250 female teachers had lost their jobs, and in the following years, more married women were systematically dismissed (Urbańska, 2011). The presidential decree of 1933 limited the possibility for female teachers in Silesia to work until the year 1938.

Measures restricting womens access to work in education were temporary. Nevertheless, the feminisation of the profession continued, especially in the area of teaching younger grades. Men became increasingly reluctant to work with the group of very young pupils, and after the World War II the staff of kindergartens and primary schools was almost exclusively female. The profession was becoming increasingly dominated by women. As a result of education reform of the early 1930s, training to become a teacher of the youngest classes offered women a quick route to social advancement. After a relatively short period of training, they were qualified to work in a low level schools. Graduating from a teacher training college did not give access to university, but it was a good alternative to manual labour in factories, where women were placed in the lowest and least attractive positions.

1.4.3. Social status and access to education

Before the effects of granting equal rights to education to women became widespread for all, the beneficiaries of educational changes were predominantly social elites. Intergenerational changes, including those concerning the social roles of men and women, were taking place most rapidly with regard to all areas of life in intelligentsia. In the late 19th century, and the years between the two world wars, youngsters from this social class wanted to make their own decisions about education, careers, and marriage. In creating more bold scenarios to pursue their own careers, different from those of their parents, the accumulated social and cultural capital helped a great deal. Its rich resources could compensate for economic deficiencies resulting from the pauperization of the landowning class, from which a large part of the young intelligentsia came.

The conditions for the realisation of even the most modest aspirations of women from the poorer strata of society were quite different. Anna Żarnowska (1985), who described the living conditions of pre-World War I workers in Warsaw, draws attention to traditional attitudes that prevailed in these families, which, together with widespread illiteracy, was a factor preventing younger generations from making unconventional (for this social class) educational choices. This this social class progress in spreading basic skills. The researcher reports that in the late 19th century in the Congress Kingdom of Poland, about 50% of men and women employed in factories could neither read nor write.

This ratio began to change with the younger generation, mainly due to the needs of industry. Vocational training courses were often the first actual educational experience for youth from working families. Although such schools did not entitle them to further education, they provided younger generations of workers with a substitute for participation in formal education. The negligible social mobility of those at the bottom of the social hierarchy and the small chances of career progression undoubtedly hampered educational aspirations of youth from this social class. We know less about aspirations of women from lower-class. In general, priority was given to boys when it came to school education, even as far as a few grades of primary school were concerned. They were the ones who would, in the future, be the link between the home and the public sphere and be in contact with offices and institutions.

Girls living in rural areas were not denied the opportunity to learn to read and write, but more often than boys they had to learn at home. This changed over time as the network of primary schools became denser and vocational education more widespread. Curiosity about the world drove young peasant women to larger cities, where opportunities for vocational training in various service industries were opening up. Those who remained in the countryside had a chance to be educated in agricultural schools. These schools taught reading, writing, geography, and arithmetic as well as practical skills in housekeeping and farming (Mędrzecki, 1992). However, access to and completion of schooling was invariably determined by the financial means of the parents.

1.5. Summary

Changes occurring simultaneously at several levels affected the acquisition of educational opportunities by women. An economy that alternated between rapid cycles of depression and prosperity, the gradual erosion of stratified society, and political instability were all factors that were disrupting the intergenerational system of inheriting property and gaining social status. The intensifying processes of industrialisation allowed enterprising individuals to increase social standing not only by accumulating family capital over the long term but also by becoming involved in modern production processes. Gradually, the social fabric whose livelihood and position depended on specialist skills was growing as well. The importance of getting professional qualifications increased with the professionalisation of banking, commerce, administration, and the media. Over generations, households were becoming increasingly dependent on earned income rather than inherited wealth.

In the midst of this transformation, which lasted throughout the 19th century, the question of equal rights of women in education arose. The position of women in the family and in wider society was largely responsible for their exclusion from secondary education. Historical research suggests that they were playing a subordinate role to men. This norm continued to exist across all social classes, even when women made a real contribution to the maintenance of the family through work in home-based businesses, family crafts shops, or smaller trades. However, the concept of women's secondary education did not previously arise in social strata where female paid work was prevalent. Its origins were in economically and socially privileged circles.

An elite of female social activists, artists and intellectuals and, in some cases, politicians, consistently argued that young girls needed to be educated in proper secondary schools, and these schools should provide a structured education according to a curriculum that included scientific facts from a variety of fields. The curriculum, as it determined the possibility of taking school-leaving exams, further education at university and work in many professions in which women were absent, became an element that strongly polarised the supporters and opponents of women's emancipation. Implementing this demand was also influenced by specific conditions prevailing in various Polish provinces.

In the Russian partition, various efforts were made to establish secondary schools for girls. However, and even if initially the attempts to study in such schools could have led to better education for women, eventually they were transformed into an instrument of Russification. This policy only partially satisfied the educational aspirations of upper-class women. The most glaring example of this was the establishment of an informal, clandestine educational initiative, the Flying University. In Galicia, the economic crisis of the early 1870s was a catalyst for growing educational opportunities for girls. The tug-of-war between educational authorities and upper-class families seeking to educate their daughters lasted almost until the end of the century. The historic change of equalising the formal entry requirements for men and women to the secondary school-leaving examination led to an extremely rapid – given the speed of social processes – feminisation of the university student community. In the following years this trend systematically intensified.

2

Generational changes in education of women and men: stability and change

At the turn of the 20th century, social and formal barriers to women's access to post-primary and higher education began to diminish. However, it was not until a wave of changes in society, politics and culture after the World War II that women gained educational opportunities on an unprecedented scale. This chapter is an analysis of the origins of these changes, with a focus on advances in gender participation at key stages of education. There were more women in establishments requiring higher academic skills, but horizontally they tended to enter previously feminised faculties or those where their presence was more acceptable for social reasons. The process of feminisation has been significantly slower in the sectors that involve work with machines and technical equipment.

2.1. Changing the educational structure in Poland in the 20th and early 21st century

Proposals made in the early inter-war period to shape the education system prioritised the popularisation of primary education, accessible to both boys and girls regardless of their social status and place of living. Education within the universal school system was to be free of charge and compulsory for children from the age of seven. After completing primary education, students could continue their education in secondary schools, which were provided free of charge. These secondary schools extended the curriculum beyond the knowledge acquired at the previous stage. In almost every respect – especially with regard to school fees, compulsory school attendance and uniformity of the curriculum – these postulates were a novelty in relation to the situation in the Polish lands before gaining independence. The plans for opening primary education to everyone produced results at a fairly rapid pace. According to Statistics Poland, in 1921, 69% of children subject to compulsory schooling in Poland were covered by universal education; a decade later, the figure increased to almost 94%. In 1925, 73% of 7-year-olds were in school; in 1932, 88%. The average age of pupils fell from 11 to 10 years. The proportion of illiterates in the population also fell sharply, and illiteracy has become problem mostly for older generations. According to the 1921 and 1931 censuses, 29.7% and 6.6% of 10–14 year olds, respectively, could not read or write. However, the decline in illiteracy over the same decade was not as great for those aged 40–49 (38.6% in 1921 and 30.3% in 1931). Younger women benefited enormously from the growing number of primary schools. The percentage of illiterate women in this age group was close to that of men

(GUS, 1939). State-organised massive courses to reduce illiteracy among the adult population also contributed to such positive results. Historic research suggests that up to one million people may have been affected by the campaign to eradicate illiteracy. These educational measures ended in the early 1950s (Budnik, 2013).

Since the middle of the 20th century, there has been a steady improvement in educational attainment among the Polish population. The rate of change at the main levels of the education system is shown in Table 2.1. Starting from the lowest levels of education, it can be seen that in the period covered by the analysis there was a decrease in the share of people with incomplete primary education and no education at all and an increase in the percentage of people with secondary education. In 1960, both male and female students who continued their education after primary school represented a relatively small percentage of the population. However, in the following years, these proportions changed. In 1970, a third of Poles had education beyond primary school, and by the end of the eighties, 66% did.

TABLE 2.1. CHANGES IN THE EDUCATION STRUCTURE IN POLAND

Level of education	Year					
	1960	1970	1988	2002	2011	2021
higher	2.1%	2.7%	6.5%	10.2%	17.1%	23.1%
post-secondary, incomplete tertiary, and secondary	10.2%	13.4%	24.7%	32.6%	31.4%	32.4%
basic vocational and part-secondary	4.6%	14.5%	23.6%	24.1%	21.7%	19.6%
primary and lower-secondary	37.9%	44.9%	38.8%	28.2%	23.2%	14.8%
incomplete primary and unknown	45.2%	24.5%	6.4%	4.9%	6.6%	10.1%
total	100	100	100	100	100	100

Source: GUS.

Until the economic transition began in the 1990s, the proportion of people with this tertiary level of education had been relatively low. It was only through the system transformation that revolutionary changes occurred in this regard. In 2021, as much as 23% of Poles graduated, which, compared to the level registered before the transformation, testifies to the enormous progress in the spread of education at this level. The public belief that it is worthwhile to educate oneself spread systematically in the 1990s, and was maintained in the following decades – the intention to obtain a university diploma was declared by almost three quarters of Poles in the recent years (CBOS, 2017a). This trend only temporarily slowed down around 2010, when a decline in the gross and net enrolment rates, that is two basic measures of educational intensity was observed. The former indicates the ratio of the number of people studying in higher education to the number of people nominally assigned to that level of education, while the latter reflects the ratio of those studying at the level of tertiary education to the population in that age group (19–24 years). In 2010 enrolment rates reached their highest values since the 1990s: 53.8% (gross) and 46.8% (net), before falling towards the end of the second decade of the 21st century, but then rose again, indicating that educational aspirations remain at a high level.

The educational expansion in the second half of the 1990s and the high proportion of people entering university level are the results of a confluence of many macro-structural and individual factors. A HEI (higher education institution) diploma, even if its quality has long been questioned, has become a kind of social norm, and learning at university has been treated as a matter of course. The process of differentiation of higher education institutions in terms of prestige, statutes (public and private) and mode of education (full-time, part-time, evening) helped individuals with higher educational aspirations. The offer was only marginally available to those who had educated before the system transformation. Undoubtedly, the factor strongly shaping the aspirations of the generations of the educational boom and its stabilisation were, and still are, the expectations of employers, who have become more willing to employ people with qualifications confirmed by a diploma than those with mere competences. This practice was not entirely absent when filling positions in enterprises and public institutions before the transition, but in a mature capitalist society this relationship has strengthened. Direction of changes in the educational structure shown in Table 2.1 indicates that the young generations of Poles have adapted well to these new rules.

2.1.1. Gender differences in educational attainments

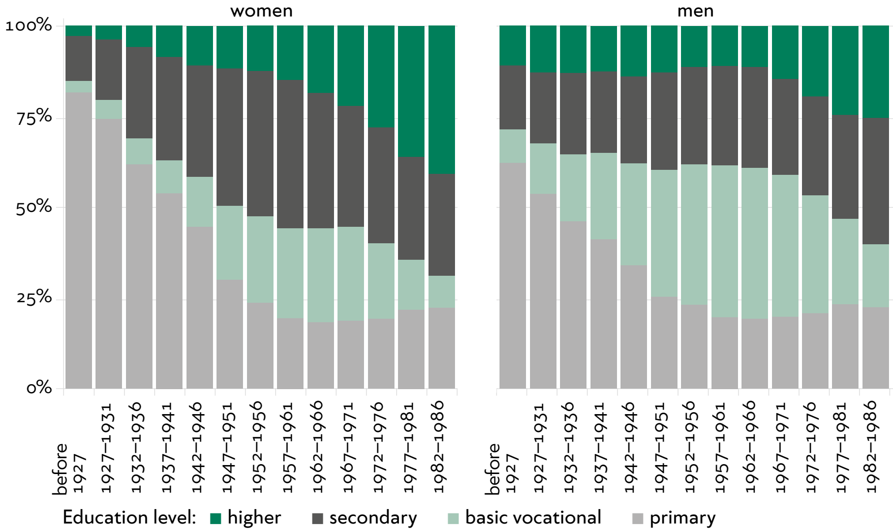
Figure 2.1 shows the education structure of men and women recorded in the censuses by five-year cohorts and on four levels: tertiary, secondary (including matriculation), basic vocational, and primary education[1]. The oldest respondents were born in the inter-war period. They made decisions about education beyond primary school in different periods of socialism. The youngest were born in the 1980s. They reached adulthood at the height of education expansion.

[1] The question from the censuses: "What is your highest level of education achieved in the educational system?". The answer could be indicated by one of 14 categories.

The majority of those born in the oldest birth cohorts (pre-1926) ended their schooling at primary level, but the gender gap is clear: 63% of males and 84% of females ended their schooling at this level. These are the cohorts that received primary education between the two wars and thus have been able to profit from the impact of the spread of primary education. Given the high levels of illiteracy among the older generations, it can also be assumed that these were the descendants of illiterate fathers and mothers, for whom completing seven years of primary school was associated with intergenerational upward mobility. There must have been a sense of such change in society and an increasing perception of a gap between their own achievements and the education of their parents and grandparents. Research under the direction of Stefan Nowak showed that, after income and wealth, education was the differentiating factor in the social status of Poles in the 1960s and 1970s (Nowak, 1981).

The share of individuals who completed their education at primary school level has been steadily decreasing in the following cohorts, which implies a better educational start for the following generations. The choice between vocational school and general secondary school had an impact on the subsequent educational and occupational paths of individuals, and, as Figure 2.1 shows, was strongly related to gender. In the cohorts born in the second half of the 1930s who entered lower secondary education after the World War II, there was an equal share of both sexes: 25% of women and 23% of men. Later on differences emerged. In the group born in the mid-1950s who decided to continue their education after primary school around 1965, gender gap in preferences for continuing education were clear – 41% of women completed secondary education, compared with 27% of men. At the same time, relatively fewer women chose to study at a basic vocational school over the whole period covered by the analysis. Young men born between the late 1950s and early 1970s were most likely to choose this type of education. In these age groups, the proportion of men with vocational education exceeded 40%. During the same period, more women (compared to other age groups) graduated from basic vocational schools, but the percentage was lower than for men: 24–26%. Among those born on the eve of political transformation, the popularity of vocational education declined for both sexes, but men still chose this type of school more often (e.g., 18% among men born in the mid-1980s, against less than 10% of women).

FIGURE 2.1. EDUCATIONAL ATTAINMENT BY YEAR OF BIRTH COHORTS*



Source: GUS, 2012b.

* Figure covers individuals aged 15 and older.

The share of tertiary education graduates has also changed. In the oldest cohorts, this category represented a negligible proportion of the total population, but there was still a marked gender gap in favour of men (women 2.9%, men 11.4%). This changed quite quickly, as among those born between 1942 and 1946, already 10% of women had a university degree (compared to 14% of men). Since then, and even a little earlier, the proportion of women with a tertiary degree has risen steadily in each successive generation. A similar trend did not apply to men, as the proportion of those with a university degree remained fairly stable (11–15%). Only the younger cohorts of men were more likely than their fathers and grandfathers to have attended university. There is a particularly large difference between men born in the late 1960s and early 1970s and those born in the first half of the 1970s (some of whom made their decision to study at the beginning of political transformation). In the former group, 12–15% of men had tertiary education, and in the latter group, as many as 20%.

The educational attainment of women shifted in a similar direction, but the changes occurred earlier: the percentage of those with a university degree already increased to around 20% in the 1962–1966 cohort. It reached 23% in the next age group, and 30% among women studying during the period of high unemployment, hyperinflation, and development of private education (those born from 1972 to 1976). In the youngest cohort, the proportion of women with tertiary education was 44%, while men – 27%.

The increasingly visible impact of higher education on wages, career progression, and reduced risk of unemployment after 1990 may have promoted the educational aspirations of later-born men. At that time, university degrees and qualifications became real capital on which careers could be built. The emergence of this new career path was an alternative to careers that required a foothold in influential circles or reliance on contacts in the communist government structures before economic transition in 1990s. Education, which required many years of conscientious performance of duties, was also the opposite of the careers of private entrepreneurs who have developed their own businesses from the 1980s onwards by balancing on the edge of the law or crossing it (Jasiecki, 2002; Palska, 2002).

When interpreting intergenerational and gender differences in education attainment, it is worth mentioning the importance of the transmission of educational values between parents and children as a potential factor influencing educational choices. Mothers tend to act as role models in transmitting educational attitudes to their children. They are generally the ones who bore most of the responsibility for raising children and also for educating them. Research suggests that maternal education was an important element in determining intergenerational educational mobility, especially as regards daughters (Stasińska, 1985). Born in the post-war period mothers, who gained better and better education, instilled ambition in the next generation. By social convention, the next generation aspired to achieve at least the same level of education. In families where gender roles were relatively traditional, fathers were the role models for sons and their academic performance became the reference point for boys' educational choices. If the fathers had a lower level of education, it was very likely that the same degree (usually basic vocational) would also be passed on to the sons. This pattern of inheritance was particularly prevalent among workers and rural dwellers, whose educational advancement was much slower compared to women. Consequently, the educational attainment of men was 'frozen' for many years and showed little tendency to change.

TABLE 2.2. EDUCATIONAL ATTAINMENT OF THE 25–29 YEAR OLD COHORT BY GENDER IN 1970, 1988, AND 2011

Level of education	1970		1988		2011	
	Women	Men	Women	Men	Women	Men
higher	4.9%	5.7%	8.6%	7.2%	44.5%	27.9%
secondary	24.3%	17.9%	47.4%	28.2%	31.4%	37.5%
basic vocational	10.1%	22.8%	29.9%	49.6%	9.8%	18.8%
primary	60.7%	53.5%	14.1%	15%	14.2%	15.8%
total	100	100	100	100	100	100

Source: GUS, *Population by level of education 1921–2011.*

Table 2.2 shows the education structure of people aged between 25 and 29. This is a group that has already had the opportunity to complete their studies in the most typical course of their schooling. The results of the national censuses show that in 1970 there were significantly more women than men who obtained secondary education (more than 24% and almost 18%, respectively) and that in 1988, this was almost half of the women and a third of the men. Over the same period men were most likely to be educated in vocational schools (over 49%). The proportion of men with secondary education has been lower in each successive generation. Therefore, even assuming that all secondary school leaving certificate holders in a given cohort would have chosen to enter university, there would have been relatively fewer men than women among the students.

The above analyses present educational biographies of several generations of Poles who have made their choices about schooling under different – in some cases radically different – social conditions. Figure 2.1, which illustrates changes in the educational attainment of women and men, also shows a partial link between individual choices and the economic conditions of respective cohorts, the directions of education policy, and social perceptions of formal education. For many women and men growing up at the turn of the 21st century, the current demand for certified qualifications and the pressure to obtain higher education, regardless of its quality and the future benefits of this investment, were likely to affect their aspirations. However, while living in the same social and economic environment as men, women tended to invest more in education. At least to some extent, employment stability and the predictability of one's economic situation could be maintained through a career based on education. In the face of the increasing destabilisation of labour market and the unpredictability of employment, having capital in the form of knowledge and skills confirmed by a university degree became an important argument for women when making schooling decisions. This is probably one of the factors that has contributed to the unprecedented gender educational divide in contemporary Polish society: according to the results of the 2021 census, 26% of Polish women had a university degree, compared to 19% of men (GUS, *Population by social characteristics – preliminary results of the 2021 census*, bit.ly/3JZx9I).

2.1.2. Women's professional situation after the World War II

The above analyses indicate that the post-war generations of both women and men have experienced a rise in educational attainment. In addition to the opportunity of intellectual development and the attainment of a higher social position, the main impetus for aspirations was the economic benefits of gainful employment. For women who had been excluded or marginalised from the labour market for social reasons, gaining an education was preceded by changing the way they earned their living. Firstly, the economic situation of many households worsened as a result of the World War II. This was felt most acutely by families who lost their main breadwinner or property. Many wives and mothers could not support themselves and their families. Secondly, women's individual entrepreneurship, whether through casual trade or home farm work, was scarce. With the impoverishment of the upper and middle classes, there were fewer opportunities to work as a domestic servant, which had been a very popular form of employment among working women in the inter-war period. The scale of unemployment and resulting poverty became a major social problem. State authorities and women's organisations recognised that there was a massive shortage of jobs for women, not only for those with low or no qualifications but also for those with work experience or those who had completed some form of education. Employment was, therefore, sought both by women struggling to survive economically and by those for whom work was emancipatory.

The situation was different for the two groups. The official rhetoric pointed mainly to a lack of qualifications and formal education as the cause of women's unemployment. Given the educational attainment of women entering the labour market as adults after the World War II, this diagnosis was probably accurate. The 19th century saw a growing trend towards emancipation, but only a handful of elite women could obtain a secondary school leaving certificate and a university degree. The system of vocational education, where girls from the lower classes could learn and gain a qualification, was almost non-existent. Attempts were made to mitigate this problem soon after the war, but the measures taken were inconsistent and generally ineffective. Natalia Jarska (2015) reports that a vocational training programme for women was in place between 1947 and 1950, but the vast majority of female graduates of these courses, despite gained qualifications, could not find employment due to the post-war economic crisis (including a lack of raw materials and markets). The doctrine of gender equality that had been in force in Poland since the early 1950s was seriously undermined by women's unemployment. The idea of gender equality was intended by communist authorities and propaganda messages to be implemented primarily in factories and companies, where women – especially the less educated and illiterate, mainly coming from rural areas – were to build socialism on equal terms with men (Fidelis, 2015; Jarska, 2015). In the idealised vision that dominated media coverage during the Stalinist period, ordinary, poor girls were given the opportunity to improve their social status by being promoted from domestic help positions to unskilled factory workers. It was promised that after completing relevant courses, they would be able to obtain higher positions in the organisational structure of industrial enterprises. Women were also promised opportunities to work in occupations other than those stereotypically associated with their gender, for example, locksmithing, bricklaying, and mining.

Promises of this kind, including raising vocational qualifications, have been largely unfulfilled. The demand to integrate women from working class and rural backgrounds into the male workforce of factories and plants sounded attractive in speeches and proclamations but was difficult to implement. The result was a contradictory policy that, on the one side, pushed for greater feminisation of traditionally male occupations, but on the other side obscured or prevented such changes. Natalia Jarska (2015) points out that in the 1950s officials supported the idea to bring women into manual jobs previously held by men, but this possibility was effectively blocked on the grounds of their lack of qualifications. Meanwhile, women's opportunities for further training were limited and impeded by a variety of factors. Men were given a priority access to vocational courses, but even if a woman completed the training, she had fewer opportunities to do the job for which she had been trained than the men did. Official recommendations from the communist authorities requiring factories to employ a certain number of women in certain industries and positions were also ineffective. These directions were not enforced, while admission to work was usually decided by factory management, which was generally reluctant to introduce women into "male" territory. Ignorance, resistance, and inattention characterised the attitude of company managers towards plans to employ women in positions equivalent to men in terms of salary and rank (Jarska, 2015). When female employees were hired, they tended to work in auxiliary positions and low complex jobs, which did not allow them to influence the tasks at hand. Moving to "male" positions was not associated with improving their economic and professional situation.

As a result, in the 1950s females were marginalised in companies and factories. They had limited opportunities for promotion, obtained lower wages, and were relegated to the most routine and mundane tasks. Because of the prevailing patriarchy, female workers were mistrusted, treated with resentment, and even exposed to aggression. Male-dominated work teams and management created an atmosphere of hostility towards women. In various ways, they signalled to women that they were not wanted in the workplace. Furthermore, the lack of acceptance of women working in masculinised occupations was not only shared by conservative male factory workers. The opinion that traditionally masculine occupations were not suitable for the opposite gender was dominant among the male population, but it was also shared by the majority of women (Jarska, 2015).

In the mid-1950s, in the atmosphere of competitiveness and competition that accompanied the implementation of the country's post-war recovery plans, the narrative regarding the employment of female workers in male positions has changed. Again, women were encouraged to pursue traditionally "female occupations". The negative side of women's employment was highlighted by the mass media, which had previously portrayed women workers in a heroic convention. It was suggested that they were being mistreated, overburdened with responsibilities, and were working beyond their capacity. Mothers were criticised for being absent from home. They were blamed for the breakdown of family ties and the neglect of children. Single women who moved out of rural communities and were placed in workers' hotels in the cities were accused of engaging in "immoral behaviour" that did not conform to the traditional model of femininity. The prevailing narrative used tried-and-tested stereotypes, emphasising gender differences in occupations, talents, and aptitudes. Once again, women were supposed to be housewives, not factory workers.

The impact of this turnaround in the discourse on women's work became apparent when the introduction of a new employment policy necessitated redundancies. Factory managers could decide who will be dismissed based on various factors related to personal life situation of workers, including the employment of family members. Female workers began to fear that they would lose their jobs, and in some cases these fears were not unfounded. For female workers, even the lowest skills could act as an advantage in keeping their employment and as a defence against being marginalised and reduced to the most menial, unstable, dirty, and poorly paid jobs. Formally recognised vocational qualifications could protect women from redundancy in the event of economic downturn and decline. In the 1950s, such an advantage, although not always quantifiable in monetary terms, was already conferred by completing short cycles of vocational training (Fidelis, 2015; Jarska, 2015). The feeling of being at risk of losing one's job would not leave the women born in the following decades either. The fear of being fired or having difficulty finding a job, expressed by female workers in the 1960s, accompanied women entering the market in the 21st century.

Changes in women's employment policies in the post-war period were part of the development of a framework within which individual approaches to the education of the next generation were born. The economic and social realities of the 1950s and 1960s that poorly educated women struggled with may have had an impact on their thinking about their daughters' education in a number of ways. Firstly, historical records have consistently shown that women were not welcome in physical occupations that were traditionally "masculine" (Fidelis, 2015; Jarska, 2015). There was resistance from colleagues, superiors, society, and even the Church to women working in a masculinised environment. This resistance was generally justified on moral grounds (the desire to preserve the traditional division of social roles). This situation was conducive to the employment of both genders in positions that were, in society's view, appropriate to their social roles. In factories and offices alike, women were relegated to jobs that were generally considered better suited to their needs: clean, sedentary, not involving the use of physical force, but which required intelligence, dexterity, perception, and perseverance. Secondly, there was increasing pressure on manual workforce to acquire vocational skills during formal education. While in the 1950s semi-literate men could still get jobs in factories, a decade later applicants were expected to have completed basic vocational schooling. This qualification could be obtained at factory vocational and technical schools, but it is worth noting that in the mid-1950s, many of these institutions had a policy of segregating genders, preventing women from studying "male" subjects. Smaller numbers of women were also sent to workplace-organised courses to improve their qualifications in professions such as lathe operators or metalworkers (Jarska, 2015). Over time, segregation in enrolment to vocational training contributed to the widening of the gender gap in occupational qualifications and, as a consequence, a widening of the gap in occupational positions and salaries. Selection and self-selection into vocational courses, training, and vocational education corresponded to the belief – shared not only by the workforce but also prevalent in society – that there was no place for women at the factory machines. In companies and factories (with a few exceptions) they had no access to senior and junior management positions and rarely supervised the work of crews. Instead, they were willingly given the simplest jobs, which in principle closed the door to promotion. Educational biographies of the next generation of females show that a significant number of women, aware of these barriers and unfavourable circumstances, opted for general education leading to white collar jobs rather than manual work in a factory or steelworks. It can, therefore, be said, somewhat perversely, that the post-war plan for the professional emancipation of women from the lower classes succeeded not by encouraging them to participate in the industrial modernisation of the country, but by "pushing" them into white-collar jobs.

2.2. Educational choices under communism

Immediately after the World War II, the education system started to be rebuild based on the socialist model. From the analyses of historians, sociologists, and educationalists, we know that "carrying the torch of enlightenment" wasn't the only task of schooling – it should also have achieved additional social and political goals (Palska, 1994; Grzybowski, 2013; Antonowicz, 2015). Improving the position of social groups who before the war neither had access to education nor the opportunity to achieve a higher social status and benefit from the achievements of civilisation was an important rationale for introducing changes in education. The new school system was to remove these restrictions. Schools, especially higher education institutions, became the breeding ground for a new intelligentsia – a social category made up of individuals of working class and peasant origin with the "right" beliefs and a certain political awareness. The measures taken to achieve this goal were particularly radical immediately after the end of the war. One element of the rapid advancement policy was the provision of fast-track preparation courses for university education, available until the late 1950s. The preparatory programmes which lasted, on average, two years, were intended for people with primary or incomplete primary education (Palska, 1994; Grzybowski, 2013). Initially, young people who had previously been denied the opportunity to study could benefit from them, but over time, the selection criteria became ideologically driven and it was mainly politically "aware" people who were admitted. The majority of students were men (over 80%) who had completed primary school, most of whom came from peasant and working-class families (Grzybowski, 2013). Such gender imbalance was only recognised after the courses had been running for several years. As a result, there were some attempts to include more women in the preparatory programmes but they proved ineffective as the priority was to educate young people from lower social classes. About 60% of the participants completed the preparatory courses, but only a small proportion of them entered higher education (Grzybowski, 2013). Barriers related to social status – lack of adequate skills, insufficient knowledge due to neglect at earlier stages of education, and lack of refinement – were factors that made it difficult for preparatory course graduates to complete tertiary education and become established in the academic environment of the "old" (pre-WWII) intelligentsia. Similarly, the effect of increasing the representation of young people from rural and working-class backgrounds at university through a system of awarding additional points "for origin" during admission was also modest. Apparently, those state programs did not compensate for the disparities in educational aspirations, cultural capital, and social conditions between different social classes. Throughout the times of the Polish People's Republic (PRL), university education, regardless of affirmative action campaigns, was primarily available to young people enjoying additional capital (Białecki, 1999; Zawistowska, 2012).

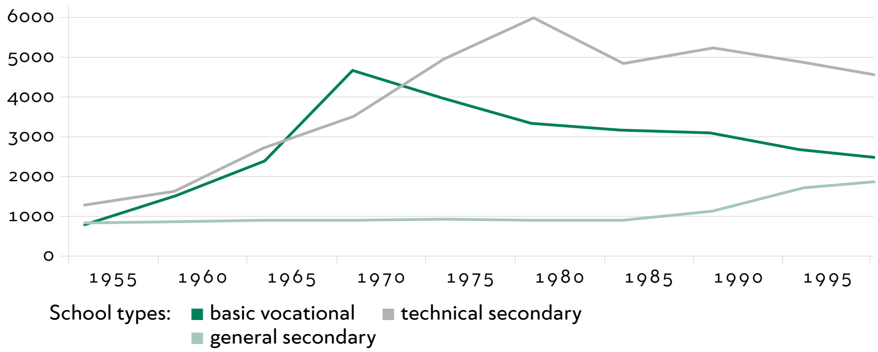
However, those lacking sufficient skills and social capital were not excluded from access to education. Young people from working-class and peasant families were encouraged to gain vocational qualifications. This was achieved through an extensive network of vocational schools and school dormitories across Poland. Admission to vocational schools was accompanied by a related propaganda message in the post-war years when more than 300,000 unskilled workers and more than twice as many skilled workers were needed to implement the first six-year plan (Miąso, 1984). Young people from villages and small towns were encouraged to attend vocational schools through the presentation of workers in a heroic convention and the positive valorisation of simple manual labour (Barański, 2011).

In order to fulfil the plans for modernising the economy, the educational authorities tried to attract to vocational education as many students as possible, taking into account their differing aspirations, social background, and previously acquired education. This approach was reflected in Government Presidium Resolution No. 448 of 23 June 1951 on the Vocational Education System [Uchwała nr 448 Prezydium Rządu z dnia 23 czerwca 1951 r. w sprawie ustroju szkolnictwa zawodowego (M.P. 1951 nr 59 poz. 776)]. This ruling established four types of vocational schools, which differed in terms of curriculum, students' age at admission, qualifications obtained, and the length of the education cycle. The two-year basic vocational schools (*zasadnicza szkoła zawodowa*) and the four-year technical secondary schools (*technikum*) for graduates of seven-year primary schools offered vocational qualification. The basic vocational schools provided qualifications for manual, routine workers, while the technical secondary schools offered the possibility of taking the matriculation examination in addition to the possibility of obtaining vocational qualifications. As a result of the differences between the two schools in terms of entry requirements, the demands placed on students during their education, and the qualifications awarded, these schools were very different in terms of their social composition, with technical secondary school students predominantly coming from families with higher social status. Older students (especially those from rural areas) who had dropped out of the education system early and had not completed primary school were offered several months of vocational schooling (*przysposobienie zawodowe*). Skilled workers could supplement their education by attending a master school (*szkoła majstrów*), (Miąso, 1980).

The importance of vocational schools in the youth education system was confirmed in the school reform of 1961, introduced by the Act of 15 July 1961 on the development of the education system [Ustawa z dnia 15 lipca 1961 r. o rozwoju systemu oświaty i wychowania (Dz.U. 1961 nr 32 poz. 160)]. The authorities intended to expand the entire vocational education sector both in terms of quantity and specialisation. Training profiles were to be narrow and tailored to the needs of local industry sectors. As a result, in the basic vocational schools, where the training lasted (depending on the moment in time) either two or three years, the students were trained in more than 200 specialisations, most of them related to the restricted industries. The result was a narrowing of specialisation to training in simple, repetitive tasks in the operation of machinery and equipment.

A reduction in the costs of education for students and their families helped to make vocational schools more attractive. However, additional financial support was mainly available to those whose vocational qualifications were most useful in the industrialisation of the country. Young people in mining and metal casting are an example. In this group, up to 95% of students received scholarships in their first year of study, compared to one-third in other technical specialisations (Barański, 2011). The generosity of educational authorities was also less evident towards young people trained in less important specialisations, and it was limited to practically zero for students in general secondary education.

FIGURE 2.2. THE NUMBER OF DIFFERENT TYPES OF SECONDARY SCHOOLS BETWEEN 1955 AND 1995



Source: Data from the GUS Statistical Yearbooks 1956–1995.

Due to their secondary function in the process of the country's economic modernisation, general secondary schools (*liceum*) were not the focus of the educational authorities. In the mid-1960s it was expected that no more than one in three pupils leaving primary school should be taught in general secondary schools (Miąso, 1980), and the educational network was subordinated to this concept. Consequently, until the 1990s, general secondary schools were far fewer than other types of schools, and their enrolment growth was slower (Figure 2.2). Between 1960 and 1970, when the post-war baby boom generation entered the education system, there was a 125% increase in the number of students in basic vocational schools, a 119% increase in the number of students in technical secondary schools and only a 59% increase in the number of students in general secondary schools. At the same time, there was an increase in the number of general secondary schools in the countryside. There were far fewer of them than in cities, but the percentage increase in this type of school was greater. Between 1966 and 1970, only three new general secondary schools were established in the cities (out of a total of 793), and a further 30 were added to the 68 existing schools in the countryside (GUS, 1977).

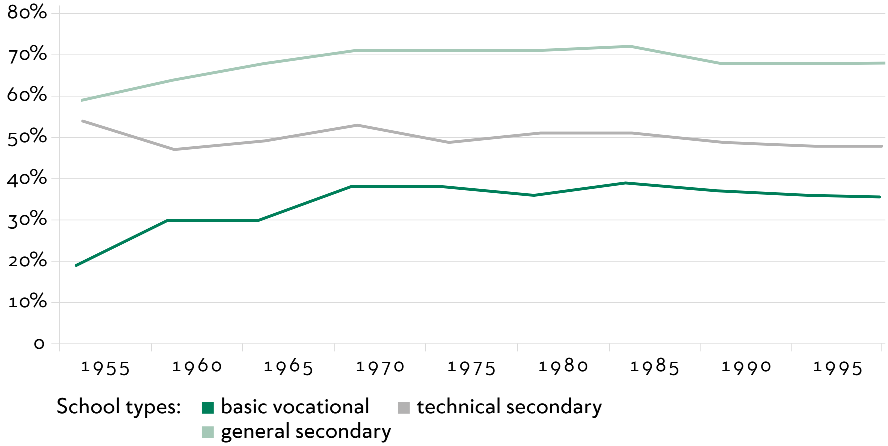
General secondary schools were educating graduates of eight-year primary schools from the mid-1960s. The task of these four-year schools, in contrast to basic vocational schools, was to prepare young people for university studies or upper vocational education. At the beginning of the 1970s, the education law was amended with regard to the possibility of leaving lower secondary school without taking the matriculation exam. The purpose of this amendment was the creation of an additional threshold for students' admission to university. This plan did not fully succeed, as initially only 28% of students took advantage of the opportunity to complete their secondary education without a matriculation certificate, and ten years later this figured dropped to just 12% (GUS, 1979a). The graduates of technical secondary schools were much more likely to use this route: 49% of them obtained a school-leaving certificate without *matura* in 1970, and 35% ten years later. This may be an indication that the educational plans of students of these schools were relatively less closely linked to university studies.

Various post-secondary schools were intended to satisfy the growing demand for education from young people who, due to the social selections, were unable to find a place at a university. The authorities were alerted to the problem of the lack of "permeability" between secondary school and university as well as to the problem of the huge disproportion between the number of students in secondary schools and vocational schools. These problems were discussed, *inter alia*, in the *Report on the State of Education in the People's Republic of Poland* (Komitet Ekspertów dla Opracowania Raportu o Stanie Oświaty w PRL, 1973), which stressed that in the long term, the mass education of manual workers in basic vocational schools would not meet the country's modernisation challenges and that personnel with higher skills would be needed. It was only the reforms introduced after 1990 that changed the structure of post-primary education.

2.2.1. Masculinisation of basic vocational schools and feminisation of general secondary schools

Basic vocational schools played a key role in the education system, not only because they were hubs providing a labour force for industry. They were also an important link in the process of gender selection. Throughout the entire period of the People's Republic of Poland, it was mainly men who chose to study at vocational schools (on average a little more than 60% of the students). A different pattern was observed in the gender structure of general secondary schools. Female students chose general secondary education much more often than males. This difference increased from 1970 to 1980 when it was more than 70% in favour of women. It remained at a similar level until 1990 when slightly more boys entered general secondary education (Figure 2.3). The feminisation of general secondary schools, which offered better chance of university enrolment than technical schools, was one of the reasons for the subsequent predominance of women in tertiary education.

FIGURE 2.3. PERCENTAGE OF WOMEN IN VARIOUS TYPES OF SECONDARY SCHOOLS BETWEEN 1955 AND 1995



Source: GUS Statistical Yearbooks 1956–1996.

The coming change in higher education can also be understood based on the absolute numbers of female and male graduates from general secondary schools. In the school year 1970/1971, 47,190 women and 18,817 men graduated from these schools (GUS, 1971), and in the school year 1980/1981, 75,616 and 29,636, respectively (GUS, 1982a). Little had changed by the beginning of the next decade. In 1990, just before the reform of the tertiary education sector, female general secondary school graduates amounted to 76,276 and the number of male graduates was 30,460 (GUS, 1994).

The state education authorities recognised the problem of gender imbalance among students in vocational schools. The need to regulate this issue was emphasised, among other things, in a special instruction issued by the Ministry of Education and Higher Education in 1967 (Official Gazette of the Ministry of Education and Higher Education, 15 May 1967, items 16–23 [Dziennik Urzędowy Ministerstwa Oświaty i Szkolnictwa Wyższego]). The document stressed the need to increase the proportion of women in basic vocational schools in technical and industrial courses that corresponded to their mental and physical abilities. At the same time, there was a call for an increase in the number of boys in general secondary schools. The implementation of these plans was to be the responsibility of the superintendents of individual school districts, who were to increase the proportion of women in certain specialisations in vocational schools through various affirmative action measures, mainly taking the form of school visits and discussions with female students (Wieruszewski, 1975). However, these measures did not bring the desired results.

TABLE 2.3. SHARE OF MALE AND FEMALE STUDENTS BY SPECIALISATION IN BASIC VOCATIONAL SCHOOLS AND THE RELATIVE SIZE OF THE SPECIALISATION* IN THE 1972/1973 SCHOOL YEAR

Specialisation	Percentage of boys in a particular specialisation among all male students	Percentage of girls in a particular specialisation among all female students	Percentage of students of the specialisation among all students
mechanics	53.1%	12.5%	37.6%
electrical engineering	12.3%	5.1%	9.6%
agriculture and forestry ♀	3.8%	16.7%	8.7%
commerce ♀ ♀	0.2%	15.9%	6.2%
construction	7.6%	3%	5.8%
multifunctional	4.9%	6.2%	5.4%
communications	7.6%	0.4%	4.9%
clothing ♀	0.2%	10.5%	4.1%
catering ♀ ♀	0.5%	9.3%	3.8%
food industry ♀	1.2%	4.8%	2.6%
timber industry	2.8%	2.2%	2.6%
textile industry ♀	0.2%	4.9%	2%
other	5.6%	8.5%	6.7%
total	100	100	100

Source: Zawistowska, 2015.

* The size of the specialisation is the percentage of students in a particular specialisation among the total number of students in the schools concerned. The ♀ mark indicates feminised specialisations, where women accounted for more than 70% of all students.

Gender segmentation was particularly strong in basic vocational schools. Table 2.3 shows the distribution of women and men between specialisations offered by the basic vocational schools in the early 1970s (when these schools were at their peak). Boys were heavily concentrated in the mechanical specialisation, which at that time accounted for more than half of the students of this gender in vocational schools. Significantly fewer chose other specialisations, including electrical engineering and construction. Unlike boys, girls did not focus on a single type of training. Although mechanical specialisation was relatively popular among them, girls were more likely to choose training in traditionally female occupations: commerce (preparing to work as a saleswoman), clothing (dressmaking), and catering, where they accounted for more than 70% of students.

Table 2.4 shows the educational choices of male and female students after primary education between 1960 and 1985. The proportion of girls enrolled in some form of post-primary education rose markedly. In 1960, the rate was significantly lower than for males, but in the following years, the ratios were close to equal. There is a lack of detailed quantitative data to determine the subsequent choices of female pupils who did not continue their education. Also, information that would indicate the reasons for these decisions is also lacking. It can be assumed that traditional gender roles, which limited their educational opportunities to a greater extent than those of men, continued to influence the educational choices of the generation of women born just after the World War II. Girls from working-class and peasant families were particularly affected by such traditional beliefs. Hanna Palska (2002), describing the educational outcomes of individuals from lower social status born in the 1950s, points to the pressure families put on their children to become independent quickly and the lack of any support in choosing their education pathway. Education, if it was considered at all in such communities, was supposed to be short-lived, vocational and, in the case of rural women, designed to prepare them to work on the farm and to help their husbands. Palska (2002) also pointed out that unplanned motherhood and the inevitable marriage that followed were still strongly influencing the educational choices of this generation of women. Prematurely becoming a mother and a wife effectively closed off educational and professional opportunities for women.

TABLE 2.4. SECONDARY SCHOOL DECISIONS IN THE YEARS 1960–1985

	1960	1970	1975	1980	1985
Percentage of students continuing their education beyond primary school					
female	73.1%	88.7%	93%	97.4%	96.3%
male	83.8%	85.8%	93.9%	98.2%	97.3%
Post-primary education obtained:					
basic vocational					
total	**47.2%**	**61.5%**	**58.3%**	**55.7%**	**55.9%**
female	36.6%	50.1%	45.6%	43.2%	43.3%
male	57.6%	72.8%	70.9%	68.2%	68.8%
general secondary					
total	**32.7%**	**20.1%**	**21.1%**	**18.5%**	**20.5%**
female	43.5%	29.1%	30.4%	26.5%	29.7%
male	22%	11.2%	11.9%	10.6%	11.1%
technical secondary					
total	**20.1%**	**18.4%**	**20.6%**	**25.8%**	**23.6%**
female	19.9%	20.8%	24%	30.3%	27%
male	20.4%	16%	17.2%	21.2%	20.1%

Source: GUS, 1979a; 1985a.

Among those students who continued their education after primary school, gender segmentation follows the pattern shown in the previous analyses (Table 2.4). Women tend to opt for general secondary schools, men for basic vocational schools and, to a lesser extent, technical secondary schools. When comparing the different levels of education, there are some converging trends between the genders. In 1970, with the increase in the number of vocational schools in Poland, the proportion of women and men in this type of institution was significantly higher than in 1965. At the same time, the gender gap in this respect persisted: 73% of male and 50% of female primary school leavers chose vocational schools. In the following years, more than 40% of women continued their education in vocational schools, but the percentage of men reached almost 70%. It should also be noted that men "drifted away" from general secondary education, as 22% of them chose such path in the 1960s. In subsequent generations, only one in ten male students chose this form of education. The popularity of vocational schools is perhaps a measure of the success of the policy pursued by the educational authorities in the People's Republic of Poland. Ignoring the long-term effects of their actions and ignoring reports about the low quality of education provided by basic vocational schools, their underinvestment and inefficiency, the excessive diversity of specialisations, and the increasingly poor public opinion, the educational authorities of the time saw vocational school as the main channel for the upward mobility of young people from the lower social strata.

2.2.2. Educational decisions in post-secondary schools and career prospects

Vocational education and training offered some educational opportunities for women; mostly courses leading to feminised occupations. However, vocational schools were not perceived by the public opinion as an appropriate place for girls to learn. A study conducted in the 1960s by Adam Sarapata (1962) shows that, for example, the profession of locksmith was considered by parents as "not for girls". There were several reasons for such opinions. First, none of the feminised occupations offered in vocational schools were held in as high esteem as "masculine" occupations. Studies of the hierarchy of occupational prestige from the 1970s onwards show that skilled workers who worked as lathe operators, miners, electricians, and steelworkers were significantly more highly valued than those in feminised occupations requiring similar levels of education (Domański et al., 2010). This was partly due to the prevailing narrative that cherished physical, hard, and even life-threatening work done to industrialise the country. Yet, these occupations were lower in the hierarchy of prestige than those requiring tertiary education. However, there was considerable variation even within this group.

Some of the more feminised occupations had a much less positive image. One example is the low prestige associated with the profession of shop assistant, popular among girls entering basic vocational schools. Małgorzata Mazurek (2010a) drew attention to a particularly negative public perception of this occupation. Research carried out in the 1960s and 1970s showed that it was usually given a low status, placed below the professions of skilled workers. Attention was focused on shop assistants when looking for culprits to blame for out-of-stock events and missed deliveries. The perception persisted that female shop assistants were prone to theft, malpractice, fraud, and "hiding goods under the counter". At the same time, the job was seen as both easy and clean (Sarapata, 1962). This further diminished its worth in the context of the existing cult of hard work. The seemingly simple job was accompanied by enormous stress due to constant allegations of bribery and illegal sales, on the one hand, and financial liability if irregularities were discovered when calculating the till, on the other (Mazurek, 2010a).

The widespread belief among the public that female shop assistants were dishonest, coupled with the inadequate wages that failed to compensate them for this perception, resulted in a discouraging selection process for vocational schools of commerce. In the 1980s, 40% of female students surveyed by Barbara Sawicka (1981) reported that they chose to study in such institutions as a result of their failure to enrol in a general or technical secondary school. In other surveys, negative motives in the choice of such fields in basic vocational schools were reported by 28% of workers in commerce and 40% of female students in basic vocational schools with a commercial profile (Tomala, 1981).

Job prospects and conditions were no better in light industry, another heavily feminised sector of the labour market. As in commerce, women in textile production ended up in the lowest-paid jobs. Even if they were sufficiently qualified for managerial positions, they earned around 80% of the national average salary and were overlooked for promotion (Mazurek, 2010b).

Factors that discouraged women from attending basic vocational schools, or at least made them the second choice, were low wages, challenging working conditions, and the low social status of the occupations for which women were offered training. There was a lack of clear incentives for women to learn and then go on to work in "male" occupations. On the contrary, as mentioned earlier, from the 1960s onwards, there was a shift away from the previously preached idea of women working in male-dominated, physically demanding occupations. More emphasis was placed on their role as mothers, or they were urged to work in feminised sectors. Women's work in "masculine" occupations was opposed both by the management of factories and companies (who mainly emphasised the organisational problems involved) and by conservative crew members and a large part of society. It is possible that female students took these factors into account when choosing their secondary school during the vocational school expansion years. Moreover, the work-related and educational experiences of mothers, who had a greater influence on their children's educational attainment because of their dominant position in the parenting process, may have played a particular role in these decisions. Many years later, research found that young people were almost twice as likely to identify their mother as the parent with whom they would discuss planning their educational future, rather than the father (CBOS, 2019a). For women, in both masculinised and feminised courses, the consequences of choosing basic vocational schools were relatively unfavourable; for some of them, the failure to achieve more ambitious educational plans was a consequence of studying in such institutions. Surveys from the 1970s and 1980s show that girls generally had higher educational aspirations and consequently were less likely than boys to study at a basic vocational school (Kołakowska-Bajtlik, 1990). However, it is difficult to determine how many of them were actually driven by negative motives in choosing vocational schools, and how many did not have the necessary competence, motivation and ambition to attend the secondary schools.

At the same time, women were entering jobs requiring different types of skills. This was particularly evident in clerical and administrative work, teaching, and the medical professions. In the 1960s, 46% of the total female labour force was employed in this type of occupations, compared with 26% of men (Preiss-Zajdowa, 1967). In the 1970s, women accounted for almost 80% of workers in administrative, clerical, and technical jobs, and almost 70% of lower-level professions in non-technical occupation. These two categories alone employed almost one-third of women in the labour force (GUS, 1991b). They were mainly educated in technical and general secondary schools, which enabled them to continue their studies at university, while at the same time preparing them for "feminine" professions (e.g., in the fields of economics and accounting).

Female-dominated occupations differed in terms of social prestige. In a 1975 survey, the jobs of clerk and secretary in an office were ranked below that of a saleswoman. The fact was that in the public's perception, jobs involving desk work were a negation of "real" work (Słomczyński and Kacprowicz, 1979; Sarapata, 1962) performed by blue-collar workers in dirt, noise, and chemical fumes. According to Krystyna Lutyńska (1963), although it may sound surprising now, the absence of these burdens caused white-collar workers to feel inferior to blue-collar workers. Lower wages, but above all the belief that they lacked the practical skills to produce certain products, suggested that clerical work was devalued in society. The identification of work with the production of material goods was further solidified by the ideological underpinnings of socialism, which gave a higher status to manual work that (at least in principle) had immediate results and was useful. By contrast, office and administrative white-collar work did not lead to the production of goods or the creation of tangible objects. Thus, its role in the cycle of organisational operations was not discernible. It seems that the discomfort caused by the negative social perception of clerical work was likely to have been experienced primarily by men, who took as a point of reference the higher-paid and more highly valued workers in the manufacturing industry. This could have acted as an additional educational disincentive for men of lower social status to attend the secondary school.

Educational choices are influenced by a combination of individual and structural factors. I focused on the latter in an attempt to understand how the economic priorities of the time and the educational structure subordinated to them shaped the schooling pathways of generations of men and women in socialist Poland. It was overwhelmingly literate or semi-illiterate people who undertook the country's post-war economic modernisation plans. Men were privileged in that they were more likely to get educated in their families. Universal education was soon to close this gap. Women's work in factories and industrial plants was to contribute to their emancipation. In the early 1950s, the plan was that women would be part of the modernisation effort alongside men who also lacked formal vocational qualifications for work in large-scale industry. But the opposite happened. The argument that women could be equally productive workers was unconvincing to a workforce recruited from conservative rural and urban backgrounds. The sectors open to women were education, culture, and administration. These required either a general education or a university degree.

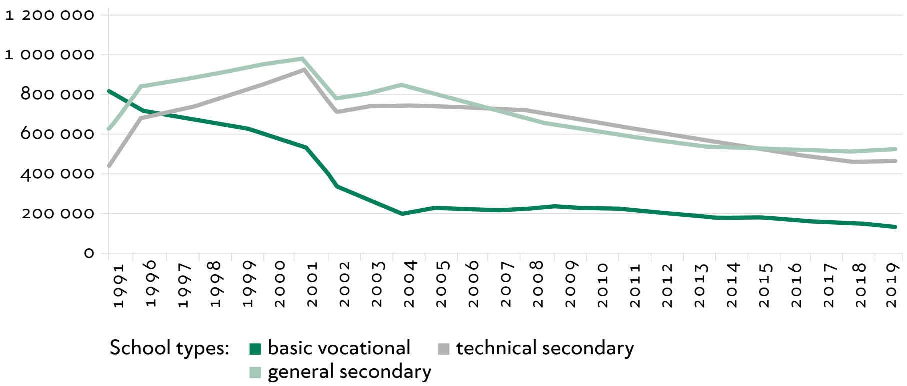
In the long run, this resulted in more losses than benefits for men, because among workers, vocational education was passed on from father to son in several more generations. Breaking out of the cycle of educational inheritance was made more difficult by a relatively centralised, inflexible education system, which basically made it virtually impossible for students to change their schooling decision once made. The choice of a vocational school strongly lowered the chance further studying at a secondary level. This factor also had a greater impact on the educational structure of the male part of the population, preserving it for many years. The upward mobility through vocational schools thus brought men from the lower social strata only temporary benefits, allowing some of them to improve their situation in relation to their parents.

The inheritance of the fathers' vocational education by the sons in the working-class families contributed to a distinctly different educational structure of the two genders. In front of women, who were not welcome in the factories, prospects for white-collar jobs in administration and offices opened. These occupations, even if they were less respected than physical jobs, became a strong incentive for the more capable and ambitious girls to enter secondary school. This opportunity was used by more and more female primary school graduates in subsequent generations.

2.3. Secondary schools after 1989

The political transformation in the early 1990s radically changed the secondary education landscape. The most important elements of the new order in education were changes in the number of different types of schools and shifts in student attainment. Until the early 2000s, the number of students in basic vocational schools (called trade schools from the 2017/2018 school year) was rapidly decreasing. In 2004, this type of institution had 70% fewer students than at the beginning of the 1990s (Figure 2.4). At the same time, the number of students in general and technical secondary education increased, although there were large fluctuations due to the size of the population in each year. At the end of the 1990s, when the baby-boom generation of the 1980s was deciding whether or not to continue their education, enrolments in general secondary schools were at their highest. However, with the exception of 1991, there has been a steady increase in the number of students in general and technical secondary schools. These changes are even more striking if we take a look at the distribution of students between the three types of schools on a percentage basis. In the school year 1990/1991, 43% of all secondary school students were educated in vocational schools, five years later 32%, and in 2018, only 12% (GUS, 2018b). Thus, while some people born in the mid-1970s and early 1980s took vocational schools into account when making their educational choices, those born after the change in the political system and making their decisions at the beginning of the 21st century have almost completely excluded this path. The role of educating young people was mainly taken over by the secondary schools, which allowed students to take the matriculation examination.

FIGURE 2.4. NUMBER OF STUDENTS IN SECONDARY SCHOOLS BY TYPE (1991–2019)



Source: GUS, 2011; 2019.

The rise in student aspirations has had an impact on the changes in the number of different types of schools. Between 1990 and 2005, the number of vocational schools decreased almost fourfold, with further decreases in subsequent years. The trend was the opposite for general secondary schools, although the dynamics were different. Between 1990 and 2003, there was a 136% growth in the number of these institutions. However, the growth pace slowed down in the following years and even reversed later, as the number of these schools fell by 14% between 2003 and 2018. The growth rate was even higher for adult secondary schools. The number of institutions educating this category of students increased by 953% from the beginning of the transition until 2010, when it began to decline faster than vocational schools for young students (GUS, 2011; 2019). This sudden increase could have signalled an upsurge in the educational aspirations of those who had made their decisions about post-primary education before the transition and were seeking to upgrade their qualifications as a result of changes in the labour market.

Basic vocational schools began to lose ground to matriculation schools not only because of declining enrolment, but also because of their public image. Basic vocational schools, which prior to the change in the system had also educated young people with a lower social status, became ghettos for youngsters with poor educational attainment, low levels of social capital, and a negative attitude towards learning. The lowering of the threshold for "entry" to secondary schools, which had previously enjoyed an almost elite status, exacerbated this process. A study carried out by Marzena Stasińska at the beginning of the 1980s on a sample of students from secondary schools found that 58% of those studying in general secondary schools, 26% in technical secondary schools, and 13% in vocational schools had a father with a university qualification. In the case of mothers, the stratification was even sharper – 4% of vocational school students had a mother with a university degree, compared with almost 70% of general secondary school students (Stasińska, 1985). After more than three decades, selection into vocational schools based on social background still existed. A survey of young people in the 2016/2017 school year found that 67% of parents of students in vocational schools were also graduates of these schools, and in technical secondary schools, this ratio was 53%. It was almost impossible to find students in this type of institution whose parents had both been educated to university level. The deepening of the social divide between the secondary schools had gone hand in hand with segregation in terms of school performance. Vocational schools never attracted high-achieving students but lowering the entry threshold to secondary schools leading to the *matura* further exacerbated selection in this respect, turning vocational schools into enclaves for those with the least potential. One striking example of this is the fact that in the study mentioned above, 17% of students in vocational schools repeated a year, compared to only 3% in technical secondary schools (Bulkowski et al., 2019). The public opinion was that vocational schools had become homogeneous communities of young men with low social standing, limited ambitions and skills and that they led to low-paid jobs or unemployment. It is worth noting, however, that this perception of vocational education and training institutions was also similar before the change of regime. According to some Poles, but also researchers, these schools were underfunded and outdated. Contrary to what was assumed, their offer was not adapted to the needs of the local labour market. Following this neglect, vocational education began to decline in the 1990s.

An additional factor that exacerbated the changes in the school structure, regardless of the individual preferences of young people, was the shrinking school-age population. The changes were extremely large. In 2020, the 10–14 age group was 37% smaller than in 1990, and the 15–17 age group was 40% smaller than at the beginning of the transition period (GUS, 2022a). Not only did vocational schools face this problem, but the number of students in general education schools was increased to a lesser extent since they were considered more attractive.

Education legislation tried to keep pace with the rapid changes in youth preferences and the declining school population (Sitek, 2019a; Drogosz-Zabłocka and Stasiowski, 2019). The Act of 7 September 1991 on the Education System [Ustawa z dnia 7 września 1991 roku o systemie oświaty (Dz.U. 1991 nr 95 poz. 425)] was the first attempt to stabilise the situation in the vocational school sector. This document regulated the entire school system in democratic

Poland. However, it made little reference to vocational schools, only in terms of defining the minimum curriculum. Specialised general secondary schools (*liceum profilowane*), whose graduates could obtain a matriculation, but were denied the right to take the professional qualification exam, were a new element in the education system. This restriction was one of the reasons for the decline in popularity of this type of institution and its disappearance in 2012. Deeper changes were brought about by the 1999 education reform. Among many other developments, this reform introduced a new way of verifying learning outcomes by means of external examinations. This was also the case for vocational schools, whose students were able to take a vocational exam to confirm the skills they had acquired from 2004 onwards. In the following years, it was also possible to leave a vocational school without passing an exam, but only with a certificate of attendance from the school. Further changes were brought about by the reform of 2016, which reorganised the education system by abolishing the six-year primary school and the three-year lower secondary school and introducing in their place the eight-year primary school. Basic vocational schools were replaced by sectoral vocational schools, with training divided into two levels: the purpose of the three-year stage I sectoral vocational school was to provide practical preparation for an occupation, while two-year stage II schools offered the possibility of continuing education focussing on already acquired qualifications. The learning at four-year technical secondary schools, which allowed earning both the *matura* and vocational qualifications certificate, was extended by one year. These changes, despite the effort put into them, seem insufficient in view of the actual challenges faced by vocational education and training. The problem is an infrastructure that is still out of date and has not kept pace with the rapid changes in the demands of narrow specialisations. This issue remains particularly relevant as a significant proportion of students choose courses in engineering and technical specialisations (GUS, 2018b), where educational quality is often strongly linked to infrastructure excellence being subject to rapid technological changes.

Education reforms have not encouraged more primary school leavers to study in basic vocational schools. Nor has it been helped by the fact that there is a lot of conflicting information about the sector in circulation, which reaches students through different channels. On the one hand, people with vocational education, especially basic education, are more likely to be unemployed than graduates from other schools. On the other hand, researchers have been sounding the alarm about the high demand for workers with practical vocational skills for many years (Sztanderska and Grotkowska, 2019).

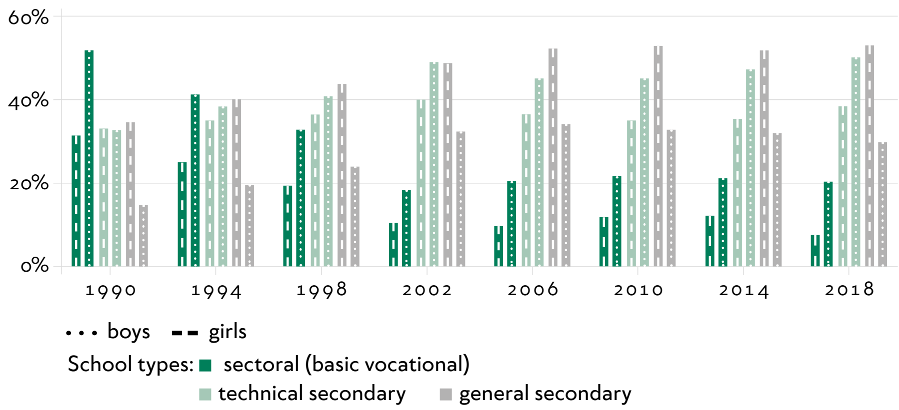
It, therefore, seems entirely justified that students are interested in school education that leads to matriculation.

Gender-based selection in secondary schools

Despite the social and institutional changes that took place in the education system after 1989, the underlying pattern of gender selection after primary school was similar to that prevailing before the transformation. Between 1990 and 2018, basic vocational schools, whose enrolment steadily declined, consistently attracted predominantly boys (Figure 2.5). In fact, this trend has slightly intensified, with the proportion of males increasing from 62% in 1990 to 68% in 2020. The decline in girls' interest in these schools is evident from the enrolment rate in sectoral stage I vocational schools (formerly basic vocational schools), which in 2020 was 19.5% for males and 9.3% for females (GUS, 2020b). The gender segregation between courses in basic vocational schools was also very high but similar to that of previous periods. In 2019, 6% of female students (and 94% of male students) attended engineering and technology courses, and in the group of profiles relating to business and administration, women made up 85% of the total number of students (GUS, 2020b). Occupational classifications have changed over the years; however, the underlying trends – the choice of technical occupations by men and clerical and administrative occupations by women – have not changed.

A growing feminisation could be observed in general secondary education. Considering all students enrolled in general secondary schools in 2018, more than half of females studied in these particular institutions, while males accounted for 29%. In 2020, gross enrolment rates for females were 65.8% and 41% for males (GUS, 2020b). In technical secondary schools, the gender ratio remained relatively stable, also with regard to the choice of education profile. Boys tended to choose technical and engineering courses, while girls chose those leading to professions involving direct contact with people. For example, in 2020, an ICT-related profile was pursued by 27% of male graduates from these schools and only 4% of female graduates. Women were concentrated in social, business, and administrative courses and especially in service occupations. In 2020, 40% of female students (and 7% of male students) graduated from technical secondary schools.

FIGURE 2.5. SHARE OF BOYS AND GIRLS IN SECONDARY SCHOOLS BY TYPE 1990–2018



Source: GUS.

Figure 2.5 shows, that gender choices are relatively stable over time. They appear to have changed only slightly under the influence of changes in the economic and social conditions of male and female students. This concerns both the choice of upper-secondary school and the choice of fields. Due to changes in the way this type of data is classified in public statistics, it is not possible to make a precise comparison over a longer period of time. However, the basic pattern has remained the same, with women tending towards social professions and occupations that will enable them to work with people later on, and boys tending towards technical and engineering jobs. The form of gender selection at the first threshold of education, which was given an institutional framework by the organisation of education in the post-war period, has not changed fundamentally.

2.4. Social status and educational choices of women and men

The analysis of gender selection processes in education is not complete without the addition of factors related to social status, which has a strong impact on the choice of education pathways, especially decisions made after primary school. General secondary schools have always attracted students from families with a higher social status, whose parents have a university degree and work in professions that are intellectually demanding. These groups place more emphasis on the education of their children and possess the cognitive and economic resources to provide schooling for their offspring. In addition, a number of studies have shown that there is a specific relationship between the social status of parents and the gender and level of education of the child. Older studies have found that boys whose parents occupied a low position in the social structure, who had simple jobs, who were poorly educated, or who had not completed any schooling at all, were more likely to be enrolled in basic vocational schools. Barbara Heyns and Ireneusz Białecki (1993) examined this relationship in cohorts born after the World War II and Marzanna Stasińska (1985) in the population of students in the early 1980s. The researchers came to a similar conclusion – the school choices of children from intelligentsia families did not differ significantly by gender, whereas schoolgirls from families of lower social status made more advantageous school choices (e.g., schools that enabled them to take the matriculation exam) than did boys.

Analyses using representative samples of people born in the 20th and early 21st centuries confirm that women were 1.5 times more likely than men to have at least a secondary school-leaving certificate (Annexe, Table A.1). To express this value in another form, we can say that the probability of this for women was 0.491 and for men 0.399. This predominance was even more pronounced when the birth year category was taken into account. The interaction of gender and year of birth showed that women were less likely than men to have a school-leaving qualification or a tertiary degree only among those born between 1911 and 1949, while the odds increased in later cohorts. The probability of having taken the matriculation examination and having completed tertiary education was 0.285 for women and 0.296 for men in the cohort born between 1911 and 1949. In the following age group, the probability was already 0.294 for men and 0.41 for women, while in the youngest age group, the probability was 0.633 for women and 0.485 for men. This result is in line with previous observations on the "divergence" of the two genders education pathways after primary education.

It should also be noted that, regardless of gender, education opportunities have systematically grown for the younger generations. This reflects the universalisation of higher education, as described above. In contrast to the cohort born between 1970 and 1979, educational opportunities after upper secondary education were significantly lower, while they were slightly higher for the cohort born between 1980 and 2006. For those born between 1950 and 1959, the probability of obtaining upper secondary or tertiary education was 0.35, while for the youngest generation, it was 0.55.

In addition to gender, the father's occupation had a significant impact on the likelihood of graduating at least from a secondary school. This factor is considered in educational research to be one of the most important indicators of a child's social status that strongly influences their future position in the social hierarchy. Looking at respondents born in the 20th and early 21st centuries, the likelihood of being educated increased more than threefold if the father had a job in the highest category (professionals and senior managers), and almost twofold for those whose fathers fell into the category of middle managers and salespeople (Annexe, Table A.1). Children from working-class families whose fathers were unskilled workers were disadvantaged. People in this category at all ages were less likely to complete upper secondary education. Being male could have further reduced these chances. Women who were born between 1911 and 2006 had usually better education opportunities than men, even after taking into account the occupation of their fathers. For example, the probability of a farmer's daughter obtaining at least a secondary education was 0.313, while for a farmer's son, it was 0.198. For the children of professionals and middle managers, the gender differences were smaller but still present: 0.801 for women and 0.778 for men in the former category, and 0.683 and 0.659, respectively, for the children of middle managers. These figures suggest that lower social status is generally not conducive to educational attainment and that men from underprivileged families had greater difficulties in passing on to the next stages of education. Women whose fathers were blue-collar workers were more likely than men with the same background to choose a more ambitious educational path. Respondents were influenced by their mothers' education in a similar way. If their mothers were less educated, their daughters were more likely than their sons to obtain a matriculation certificate or university degree, and these proportions evened out as the mothers reached higher levels of education. In general, it can be concluded that the children of mothers with a higher level of education were more likely to obtain a secondary school leaving certificate and to go on to university than those whose mothers had only completed lower secondary education.

The analyses suggest that, in the case of women, gender partially offset the negative effects of belonging to a lower social class. This was partly due to a change in attitudes, as in earlier decades daughters brought up in working--class and peasant families were prepared to become independent more quickly and their education, if it was considered, was short-lived. This was also influenced by the social norm in these social strata, which required women to stop working after getting married. Maternal responsibilities, built up over time through lack of control over one's fertility, meant that spending on women's education could not be "recouped". With the spread of women's work (including married women) and their increasing empowerment, including in the legal sphere, the situation began to change. The process of the feminisation of the service sector, in which employees were increasingly expected to have formal education, also contributed to the “pushing” of female students into general secondary education. In contrast, there were no such expectations in the sectors in which mainly men of lower status were employed. The generational dynamics of the educational structure among men suggests that it was only the impulses of the political transformation that interrupted the firmly established mechanism of the inheritance of school choice from father to son.

2.5. Summary

This chapter has examined changes in the educational attainment of men and women from a generational perspective. In recent decades, the general education trajectory has been similar for both genders. People have taken longer to get educated and the proportion of those with the lowest level of education has decreased. However, an important difference in the structure of education has emerged; in each successive generation, the proportion of women with primary education has decreased and the proportion of women with upper secondary education has increased, while men have continued to opt for basic vocational schools. The reasons for emerging the gender gap at post-primary education choices are complex. Patterns of secondary school enrolment were forged in the post-war world order, in a situation of massive social advancement and intensive industrialisation. Young men from rural and working-class backgrounds, with no experience of the education system, were given the opportunity to quickly acquire vocational qualifications and become financially independent. In practice, they were offered training in routine skills useful for physically demanding jobs and were required to work in hazardous conditions. Even when it became clear that the qualifications acquired during three-year courses were impractical, outdated, and non-compliant with employers’ requirements, the decision of men from families with a low social status to attend a vocational school was reproduced in subsequent generations. This was particularly the case for young men entering adulthood at the end of the 20th and beginning of the 21st centuries.

Vocational education and training did not exclude women, but for them the prospect of work in “male” occupations was daunting and, what is more, socially unacceptable. There was a widespread belief that they should avoid basic vocational schools, which had gained a poor reputation long before the change of regime. Women were more likely to opt for a general secondary school. Although education at this institution did not always offer the prospect of a high salary and prestige, it did open up the possibility of employment in a “socially acceptable” environment (e.g., offices, administration, schools) and university study. Women and men entered the era of education expansion in higher education with dissimilar capital and different generational experiences of education.

To what extent did the specific historical circumstances of Poland shape the different preferences of women and men? If there had not been an enormous demand for skilled workers and if general secondary education had not been of secondary importance, would the education structure of the two genders have been different? Comparative analyses show that primary and secondary education expansion in the 20th century occurred regardless of a country's level of industrialisation and economic system (socialist or capitalist). It should also be added that the educational advancement of women in the post-war period was of a universal and global nature. In countries as economically and politically remote as Poland, the United States, Germany and Sweden, women from the lower social strata who were born in the 1960s and 1970s had greater educational opportunities than their male counterparts (Shavit and Blossfeld, 1993). Jan O. Jonnson (1993), in explaining the equalisation of schooling opportunities for women and men born in Sweden until the 1960s, points to the reduction of discrimination against daughters in schooling, but more importantly to the increase in female employment and the rising expectations of employers towards women. Similar processes also took place in Poland. However, the strong selection after primary school and the socialist-defined role of vocational schools as institutions for the training of workers may have acted as an additional factor in "pushing" women into general secondary schools.

3

Women and men in higher education: describing the trends

The previous chapter traced educational decisions beyond primary education and presented evidence of a strong correlation between these decisions and gender observed over the past 70 years. Equally important changes have occurred at the university level, where women began to gain an advantage relatively soon after becoming eligible to study. This chapter describes the process by looking at two key dimensions of the gender divide in higher education: the proportion of women among all students and graduates, and their share in different groups of fields of study.

3.1. An increase of educational aspirations

Over the past 30 years, there has been a marked increase in the level of education in Polish society. The awakening of educational aspirations has taken place in parallel with the social, economic, and institutional changes that were initiated by political transformation. The rapid increase in the aspirations of those who have completed primary education can be seen in the surveys conducted since the early 1990s (CBOS, 1990; 1991; 1992; 1994; 1996a). Already between 1990 and 1992, the percentage of young people who reported that they intended to attend a basic vocational school fell from 30% to 22%. At the same time, the percentage of students who intended to pursue tertiary education rose from 25% to 32%. Between 1990 and 1996, the proportion of school with such plans increased from 25% to 57%. In the second half of the 1990s, almost all general secondary school leavers and more than three-quarters of technical secondary school leavers declared that they were going to pursue higher studies. Students at basic vocational schools were much more likely than previous generations to continue their education at technical secondary schools (CBOS, 1996a).

However, it would be a mistake to think that the rise in aspirations was driven solely by a desire for intellectual development. The above-mentioned studies suggest that the increase in educational aspirations was a result of the rapid privatisation of enterprises, high inflation, and unemployment in the 1990s. Premature exit from education was linked to unemployment and, for men, to mandatory and often undesired military service. This fear affected a significant proportion of young people. Surveys conducted in the early 1990s showed that more than three-quarters of those with tertiary education considered the threat of job loss or difficulties in keeping a job to be the most important challenge in their lives (CBOS, 1992). At the same time, similar proportion of the young people were motivated to start their higher education by the fear of unemployment. The prolongation of education was, in their view, a way of minimising "everyday risks and uncertainties" – as Bogdan W. Mach (2003) put it in describing the circumstances of people's entry into adulthood during the economic transition period. Particular to the situation of economic instability at the beginning of the 1990s, the protective function of education, sometimes called "babysitting", began to have a lesser influence on educational choices in the following years. After the initial shock caused by the introduction of free market rules had subsided and the mechanisms of the capitalist labour market became more predictable, motives for continuing education changed. From 1994, and even more so at the end of the 1990s, tertiary education gradually moved away from being a "waiting room" for hard times and more commonly became an investment in the future (CBOS, 1994; 1999a). Fear-based motivations have been replaced by the urge to satisfy personal ambitions, broaden career prospects, and develop personally. By the mid-nineties, young people were already convinced that a degree and qualifications decreased the risk of unemployment. At the same time, each succeeding generation of secondary school leavers was becoming increasingly aware that once they entered adulthood, they would have to rely on themselves; on their ingenuity, hard work, knowledge, and intelligence (CBOS, 1991; 1992). This awareness and growing self-reliance, combined with widespread fear of unemployment, c haracterised the first-in-history generation to take advantage of effects of the higher education reform.

The increase in educational aspirations did not slow down after the stabilisation of the labour market. The enrolment rates of successive cohorts were increasingly higher and the number of students grew sharply (see Table 3.1 and Figure 3.1). The two basic measures showing the prevalence of studying increased markedly between 1990/1991 and 2010/2011.

The gross enrolment ratio, expressing the ratio of all students, irrespective of age, to the population in the 19–24 age range, rose from 12.9% to 53.8% during this period, while the net enrolment ratio, expressing the ratio of students aged 19–24 to the population in the same age range, rose from 9.8% to 40.8%. After this period, a temporary decrease and then another increase in the level of both indicators can be observed.

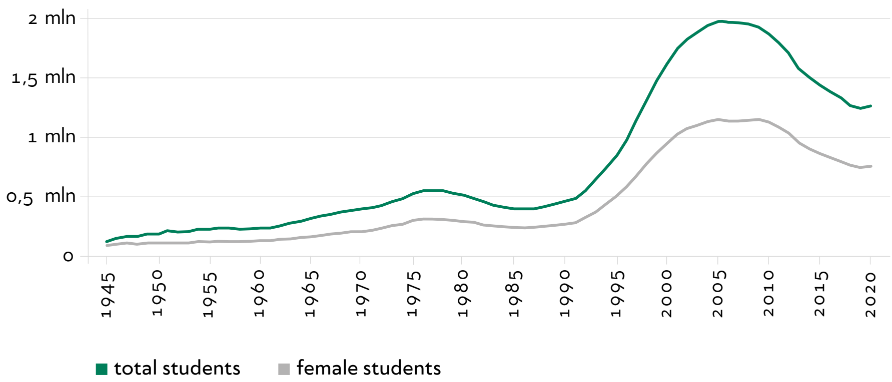
TABLE 3.1. NET AND GROSS ENROLMENT RATES IN HIGHER EDUCATION

	1990/ 1991	1995/ 1996	2000/ 2001	2005/ 2006	2010/ 2011	2015/ 2016	2018/ 2019	2021/ 2022
Gross	12.9%	22.3%	40.7%	48.9%	53.8%	47.6%	46.2%	50.6%
Net	9.8%	17.2%	30.6%	38.2%	40.8%	37.3%	35.6%	38.1%

Source: GUS, *Szkoły wyższe i ich finanse*.

This partly coincides with continued high aspirations to learn. Between 2003 and 2008, as many as 59% of both male and female general secondary school leavers said they wanted to continue their education at university. By 2018, this figure had risen to 62%. It should be noted, however, that gaining higher education and work experience is no longer in conflict, since as much as one-third of young people intend to combine their studies with work (Boguszewski, 2019).

FIGURE 3.1. NUMBER OF STUDENTS IN THE YEARS 1945–2020



Source: GUS.

The research overview above shows that the generations born in the late 1990s and early 2000s view higher education differently from older cohorts. This may be influenced by ongoing changes in the hierarchy of factors leading to professional success. Surveys show that in the 2010s, being hardworking, autonomous, individualistic and self-reliable had become more important (CBOS, 2017b). These factors have been shaped independently of the tertiary education system and, at the same time, have constituted a typical feature of the mentality of people who function in the capitalist economy system. This does not mean, however, that education has lost its importance as a factor contributing to career. The belief in its usefulness in the labour market has remained relatively high, while the confidence in the importance of non-educational factors, that had meant less in the past, such as one's own work, knowledge, effort, and entrepreneurship has increased. This trend has been noted by several researchers; Anna Baczko-Dombi and Ilona Wysmułek (2015) showed that between 1988 and 2013, the perceived importance of hard work and ambition, as factors leading to career success, increased more than the role of a good education. Therefore, it does not seem to be a coincidence that enrolment rates have been declining since 2010, while the importance of other factors (including hard work) that impact success has been growing.

Similar shifts have taken place in the hierarchy of subjective components of success in the opinion of secondary school leavers. The belief that professional success depends on individual work and effort has increased among young people. When asked what would help them find a job after leaving school, intelligence and talent came first. The percentage of people who mentioned these factors rose from 39% in 1994 to 59% in 2021. Young people surveyed in the early 2020s considered these to be more important than knowing the right people and having good connections. This is an important change, since in the mid-1990s, the opinion of young people showed that these non-meritocratic factors affected their chances of finding a job in the same way (Boguszewski, 2022).

The studies suggest that formal education, while still valued, is no longer seen as a single prerequisite for career advancement. With the deregulation of the labour market, the popularisation of non-standard forms of employment and other factors, the monetisation of knowledge and skills acquired at university has become more difficult and less predictable. Young people, and especially those who combine working and studying, became aware of these processes. At the same time, new forms of professional activity have opened up to them, only to a limited extent dependent on their diploma. In the public arena, especially in social media, which is one of the main channels of access to information for youth, you can hear a growing number of voices saying that in these times of unlimited access to knowledge, it is possible to succeed in the free market by making up for the lack of qualifications with hard work and entrepreneurial spirit.

Institutional change in higher education and its impact on educational choices

Society's increased aspirations to learn have coincided with changes in the higher education system. Recent years have seen a number of changes in the various dimensions of the system, but two of them seem to be of particular relevance in terms of gender-based selection. The first is the possibility of establishing private higher education institutions, introduced by the Act of 12 September 1990 on Higher Education [Ustawa z dnia 12 września 1990 r. o szkolnictwie wyższym (Dz.U. 1990 nr 65 poz. 385)], which abolished the state's monopoly in the provision of tertiary education and drove the spontaneous development of this education sector in a free-market (Antonowicz, 2015). The formal and unrestricted freedom to establish private tertiary education, coupled with the lack of institutional oversight of their operation led to a rapid growth in the non-state higher education sector. In 1997, there were 146 private higher education institutions, 10 years later there were 324 of them providing education to about one-third of all students (GUS, 2012a). The quality of education, especially when compared to the offerings of state universities, did not follow the quantitative growth of private institutions. Dominik Antonowicz (2015) emphasises that private universities applied less stringent admission criteria, as they were more lenient throughout the entire educational process, the completion of which (with the tacit approval of the academic staff) became a formality. The fact that, apart from rare cases, private institutions specialised in social sciences and humanities, which do not require a particularly high level of investment, also contributed to the differentiation in the quality of education between private and public universities. However, more investment-dependant disciplines, either because of the availability of academic staff or because of the infrastructural facilities required, tended to be studied in public universities. This system remained in relative equilibrium until the demographically declining cohort entered tertiary education. Falling enrolments meant that many private universities and fee-paying programmes within public universities ceased to exist or significantly reduced their activities. The lowering of admission requirements for some public universities, especially those with less prestige and poorer quality of provision, also weakened the position of private institutions. As the number of candidates decreased, universities with inferior status lowered their admission criteria. This gave secondary school graduates with poorer performances in exit exams the opportunity to study at a state HEI. Thus, the impact of demographic processes affected the entire higher education sector, although not to the same extent. It is worth mentioning that the population in the most typical age group for higher education (19–24 years) decreased by 34% between 2010 and 2021 (GUS, 2012b; GUS, 2021d).

The second transformational change in higher education institutions was linked to the implementation of the Bologna Process, bringing Polish higher education into the network of European higher education institutions and necessitated the streamlining of their operations. In many courses of study at universities and technical universities, the 5-year long cycle of study was divided into two shorter cycles (generally in the system of a three-year first cycle of study and a two-year second cycle of study). Students could diversify their final qualifications or decide on the duration of their education, which gave them more freedom to shape their educational careers. At the same time, an additional selection threshold was created within tertiary education. This filtered out those who wished to continue their education from those who wanted to enter the labour market more quickly.

The diversification of higher education institutions in terms of the quality of education and the value of diploma went hand in hand with some relaxation of social barriers to tertiary education. Rising enrolment rates indicate that tertiary education has become more available to all social classes. It is no longer only accessible to the elite, as was the case before the political change. Young people from smaller towns and cities and those who did not grow up in middle social classes have been given more opportunities than before to obtain a university education, even if in many cases this has involved personal financial outlays. However, social background still plays a role in the choice of tertiary education in Poland. According to the "queue" hypothesis, young people from higher-status families with better secondary education background have preferential access to public universities with better staff, richer curricula, and attractive career prospects. The children of less educated parents have also found a place for themselves in the diversified education system, but they tended to have access to a more modest range of educational opportunities, often with a lower quality infrastructure, earning degrees with lower "purchasing power". Social status has, therefore, stopped being a determining factor in access to higher education. However, it has continued to influence where and what the next generation of students study.

3.2. Gender-based selection in higher education

Previous analyses of secondary education have shown that at this level, girls tend to choose general rather than technical secondary schools and that students at these schools, regardless of gender, have a higher likelihood of matriculating and going on to higher education. It is, therefore, worth considering whether, once this threshold was crossed, gendered selection continued to be similarly strong. After all, it may be the case that girls are less selected than boys in general secondary schools and that they form a more diverse group in terms of ability, motivation to learn, and academic performance. On the other hand, since some of the weaker students choose vocational schools, male students may be a more homogeneous category in terms of factors relevant to the education process. It is, therefore, worth investigating whether female and male general secondary school leavers are equally likely to have a transition from secondary school to university. In this way, it will be possible to determine whether the threshold for access to higher education is the same for women as it is for men.

Analyses of students born in 1993 and 1994, who made their decision to go on to university during the period of expansion of higher education, show that women were more likely than men to go on to university after leaving school (Annexe, Table A.2). There was also a large advantage for graduates of general secondary education. Graduates from these schools were more than six times more likely to continue their studies at university than graduates from technical secondary schools. When gender and type of school are taken into account, it can be seen that women and men who left general secondary education were almost equally likely to go on to study at university. There was a larger gender difference for graduates of technical secondary education, where the chances for women were lower than for men. In other words, female graduates of general secondary education had almost the same chances as male graduates of entering higher education, while female graduates of technical secondary education had lower chances. Expressing these differences in terms of predicted probability, the likelihood of attending university after general secondary education were 0.894 for women and 0.899 for men, while for technical secondary education, they were 0.482 and 0.564, respectively. These values were also similar after controlling for factors related to SES, i.e., the father's occupation and the mother's education.

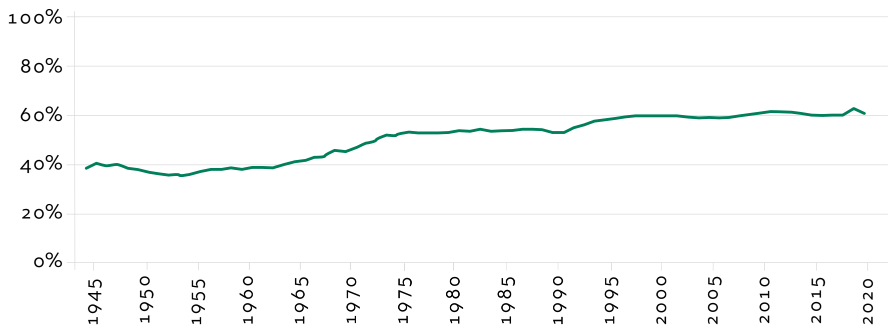
Social status played a role in HEI selection, even when the barriers to entry to higher education were lowered during the period of educational expansion. Those whose fathers belonged to the category of managers and professionals (more than twice as likely as unskilled workers) or were middle-level employees (almost twice as likely) were always more likely to go to university. The effect of social status on the chances of going to university diminished after taking into account the *matura* exam results, especially in mathematics, which significantly increased the likelihood of entering university, controlling for SES, school type, and gender.

Analyses of the cohorts born in the early 1990s show that, during the period of education expansion, gender had relatively little influence on the transition from secondary school to university for general secondary school leavers, while males had an advantage in this respect in technical secondary schools. This may indicate the existence of different selection mechanisms for male and female students. The number of boys leaving primary school is decreasing as a certain number of them – especially those of lower social status and less able – move to vocational and technical schools. On the other hand, boys with higher cultural capital and academic performance are more likely to choose secondary schools. They form a relatively homogeneous group with higher educational aspirations. Girls are subject to these selections in post-primary education to a lesser extent, as a smaller proportion of them choose to attend institutions other than general secondary schools.

3.2.1. Women and men in higher education

Figure 3.2 shows the proportion of women in higher education from the post-war period to the end of the second decade of the 21st century. There was a gradual increase in the proportion of female students until the 1970s, followed by a period of gender parity that continued until the early 1990s. From the middle of the 1990s onwards, women began to make up the majority of the Polish student population.

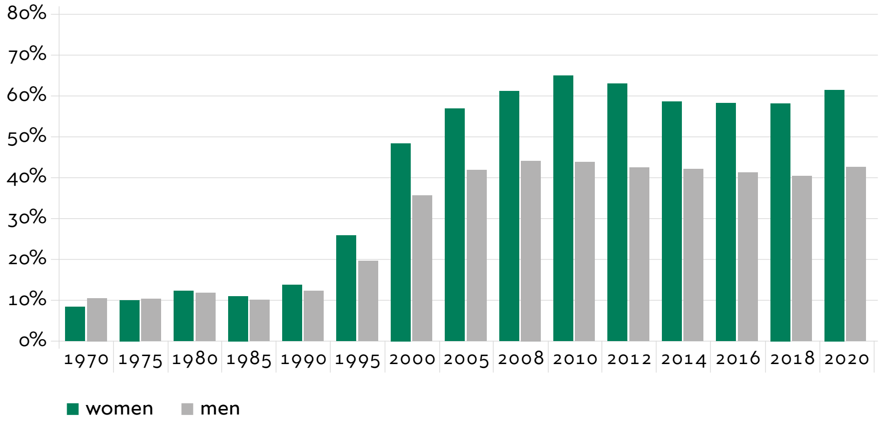
FIGURE 3.2. PERCENTAGE OF WOMEN AMONG ALL STUDENTS FROM 1945 TO 2020



Source: GUS.

Figure 3.3 looks at the difference in the proportions of women and men in higher education from a slightly different perspective. It shows the share of those studying by gender in the 19–24 age group. The share of male students among 19–24-year-olds was similar to the level of this rate among females between 1970 and 1990. The share of both males and females increased significantly for both genders in 1995; however, the increase was much greater for women. The gender gap continued to widen in the following years. From 2010, the ratio had begun to fall slightly for both genders, but the clear advantage for women continued. In the last year analysed (2020), there is again an increase in the proportion of female students in the young female category.

FIGURE 3.3. SHARE OF MALE AND FEMALE STUDENTS AMONG POPULATION 19–24 IN THE YEARS 1970–2020*



Source: GUS.

* The height of the bar is the quotient (multiplied by 100) of the number of females and males aged 19–24 and the number of students by gender.

Gender balance in enrolment was achieved in the 1970's under the specific circumstances of Polish history. The first half of the decade was characterised by rapid economic growth, which was reflected, among other things, in higher wages and household consumption (Żekoński, 2004). The economic growth and the expansion of civil liberties were conducive to awakening the educational and professional aspirations of young people. These aspirations, especially in the sphere of individual self-realisation, were blocked by the economic crisis of the in the mid-1970s (Sułek, 2004). This may have been strengthened by the fact that the relationship between education and income was no longer as close at that time as it had been a decade earlier. Surveys conducted on urban samples in the 1960s showed that higher education was strongly related to job position, income, and prestige. The relationship between salary and education was particularly evident among the intelligentsia (Słomczyński, 1972). Doubt about the value of higher education diploma was associated with the loosening of the link between higher education and other status factors. Analysing the causes of tertiary education devaluation in the 1970s, Jadwiga Koralewicz-Zębik (2008) pointed out that it lost its value in social perception. It was no longer seen as a characteristic differentiating people belonging to different social categories. Material status and income level began to play a stronger distinctive role. The belief that education would help one climb the social ladder or achieve a high professional position weakened even among the intelligentsia, who mainly benefited most from educational opportunities.

Despite the emerging symptoms of the collapse of the meritocratic system, in the 1970s and 1980s, the highest incomes went to those who managed property (managers, high-level administrators) and professionals with higher education (Janicka and Słomczyński, 2014).

The rapid widening of the gender gap at university in the mid-1990s also took place against the background of the economic crisis, albeit manifesting itself quite differently. The adverse effects of the changes fell on the less educated, whose qualifications did not "fit" the new economic rules. To a greater extent than in the past, education began to be treated as an instrumental value. In the social consciousness, it became a means of career advancement or an investment in the future.

3.2.2. Graduate students

Enrolment in a university does not equal graduation. Tertiary education, as an optional level of schooling, is characterised by a much higher drop-out rate than other levels of education. The official data show that the total enrolment declines progressively in the following years, with an especially sharp decline after the first year. The statistics published by Statistics Poland do not allow a detailed reconstruction of individual dropout patterns by gender for a given year of study, but they do make a comparison of the percentage of women and men at "entry" and "exit".

Between 2000 and 2020, the proportion of women among all first-year students averaged 55%. Among graduates, however, it was on average 10 p.p. higher. This difference was not uniform across all fields of study. There were more women than men in the first year of undergraduate studies (*studia licencjackie*), while there were fewer women in engineering degree programmes. The gender gap was even more pronounced among graduates from both types of programmes. In undergraduate studies, women made up 67% of new entrants and over 70% of graduates. The same pattern was observed in engineering programmes, where the proportion of women was higher among graduates than among first-year students, although they were a minority.

TABLE 3.2. PERCENTAGE OF WOMEN AMONG FIRST-YEAR STUDENTS AND GRADUATES (BY PROGRAMME TYPE)

Programme type		2000	2005	2010	2015	2020
total	first-year students	55%	52%	55%	54%	54%
	graduates	65%	65%	65%	64%	63%
master's degree	first-year students	64%	59%	64%	65%	66%
	graduates	60%	62%	68%	67%	67%
first-cycle Engineer's studies*	first-year students	31%	24%	31%	33%	31%
	graduates	32%	31%	32%	38%	36%
first-cycle Bachelor's studies*	first-year students	67%	63%	67%	66%	66%
	graduates	72%	72%	72%	73%	71%

Source: GUS.

* First cycle programme is a three-year cycle available to holders of the secondary school matriculation certificate. After graduation, students are awarded with a first-cycle qualification.

The data show that men are more likely than women to drop out before obtaining a higher education diploma. For them, the obstacle may not be so much the transition from secondary to tertiary education, addressed earlier, but rather the persistence to graduation. However, available data is not sufficient to determine the reasons why students drop out and, even more importantly, what the recorded drop-out rates mean. There is no information on further education decisions of both genders. For example, some studies suggest that men are more likely to drop out of university for good, while women are more likely to change their field of study (Astorne-Figari and Speer, 2018). However, the dominance of women among graduates seems to be relatively constant over the years, suggesting that they may be more consistent in pursuing their educational goals. The selection during tertiary education, perhaps more than the decision to go to university itself, contributes to the gender gap in educational attainment.

Individual reasons for dropping out can vary widely, but it is reasonable to assume that such decisions are made because an alternative exists that is more attractive than the time and effort invested in studying. It is possible that the economic and social position of women is more negatively affected by their discontinuance of studies than is the case for men (having a better chance of getting a job without a degree). This may particularly concern students with a lower social status and those who are least motivated to complete their studies.

Did the phenomenon of more men dropping out of university in Poland only emerge during the expansion of education? Sociological research suggests that this pattern existed before higher education transformed into a more liberal institution. Writing about the reasons for dropping out of university in the early 1970s, Ewa Rokicka (1981) stressed the importance of social, individual, and economic conditions. For example, the risk of dropping out for men was increased by prior study in technical schools. On the one hand, these schools were less successful in imparting general knowledge, but on the other hand, they made it possible to acquire specific qualifications (and thus to start working). Another reasons for dropping out of university were individual characteristics of men such as a greater degree of neuroticism, neuroses, and an inability to adapt to the institutional life of the university. Among women, unplanned pregnancies and marriage were common causes. The consequences of dropping out were also different for the two genders. However, the lack of a university degree limited job opportunities, especially for women, who faced greater barriers to employment than men having completed secondary education. Technical school graduates predominated among managers and specialised office workers, which was much rarer among women educated alike.

A combination of various factors – personal ones that had an adverse effect on men's adaptation to the academic regime; institutional ones (school choice at secondary level resulting in men being less equipped with knowledge useful at the university level), and economic ones taking the form of labour market demand – could have contributed to the increasing share of female HEI graduates between 1955–1985, reaching parity with the proportion of men graduates around 1980.

TABLE 3.3. PERCENTAGE OF FEMALE AMONG HEI GRADUATES BETWEEN 1955 AND 1985

	1955	1960	1965	1970	1975	1980	1985
percentage of women among graduates	28%	36%	37%	41%	48%	51%	53%

Source: GUS.

3.2.3. Gender diversity in fields of study

Feminisation did take place in higher education, but not at the same pace in different fields of study. In fact, it could be argued that as soon as studies became more egalitarian, representatives of both genders immediately took up specific positions on university paths. For women, these were mainly medicine, the humanities, social sciences, and natural sciences, while for men it was mainly technical and engineering studies. There were, of course, exceptions – some people entered faculties less typical of their gender: women in engineering or construction and men in literature and pedagogy, although in some faculties, this was long seen as a departure from dominant patterns.

The official data available makes it difficult to track precisely the changes in the proportions of women and men in individual fields of study, as the classification of fields of study has undergone a number of changes over the years and the provision of higher education has also changed. However, even with limited information it is possible to identify some characteristic patterns. Table 3.4 shows the preferences of women and men between 1960 and 1990 in technical sciences and the humanities, the two groups of fields of study with the most pronounced gender correlations. It includes the percentage of women in a given field of study, the corresponding information on men, the degree of feminisation (percentage of women among all graduating students), and the size of the field of study (the percentage of graduating students in a given field of study among all graduating students in a given year). The latter is an approximate measure of the popularity of the field of study.

TABLE 3.4. GENDER OF GRADUATES OF TECHNICAL STUDIES AND THE HUMANITIES AT TERTIARY EDUCATION BETWEEN 1960 AND 1990

	1960	1970	1975	1980	1990
Technical studies					
percentage of women among all female graduates	22.3%	17.2%	14.3%	14.8%	6.5%
percentage of men among all male graduates	47.2%	49.2%	50.4%	45.9%	45.9%
level of feminisation	20.5%	19.9%	21.2%	25.7%	16.6%
relative size of the field of study	38.6%	36%	32.8%	29.8%	21.2%
Humanities					
percentage of women among all female graduates	11.6%	19.9%	14%	29.2%	43.8%
percentage of men among all male graduates	5.6%	6.4%	4.8%	8.9%	8.9%
level of feminisation	52.6%	67%	73.3%	77.7%	80.3%
relative size of the field of study	7.7%	12%	9.3%	19.1%	29.6%

Source: Statistical Yearbook of 1974, 1975, 1981, 1990 (they distinguished groups of fields of study without specifying exactly which fields of study were included in them).

Comparing the data from the five time points allows several conclusions to be drawn. Firstly, changes in the size of the two groups of fields of study can be observed. In 1960, 38% of all graduates completed their studies in the group of technical fields of study. In the following years, this percentage gradually decreased and was 21% at the beginning of the economic transition in 1990. The opposite trend was observed in the humanities, where the share of graduates increased significantly from 7.7% to 29.6%. This was due to an acceleration of a trend that had already begun in the academic year 1988/1989, when the number of students in the humanities exceeded 100,000 for the first time, while the number of students in the technical sciences had already fallen below this level in the first half of the 1980s (GUS, 1991a).

It should also come as no surprise that from 1960 until the beginning of the system transformation, women were less likely than men to complete technical studies. An analysis of the dynamics of these changes leads to less expected conclusions. The decline was particularly pronounced in 1990 when female graduates in this field of study accounted for only 6.5% of all female graduates. Compared to the early 1960s, when a fifth of all female graduates had an engineering degree, the decline was significant. The shift in women's preferences towards the humanities was already apparent in 1980 and this trend intensified in the following years. In 1990, 43% of all female graduates earned a degree in humanities, compared with 9% of male graduates (GUS, 1991a). During the period under review, the changes in the educational preferences of men were not as radical as those of women. The proportion of men graduating in technical fields was consistently high, accounting for almost half of all graduates between 1960 and 1990. Over the four decades, the proportion of male graduates in the humanities increased, although it did not exceed 9% even at the beginning of the economic transition in the 1990s. The educational choices of men were more consistent than those of women.

It is reasonable to assume that educational preferences were to some extent driven by the labour needs of a modernising economy. Businesses and factories, facing a shortage of skilled labour (due to war losses), were looking for specialists in a variety of fields. According to Jędrzej Chumiński (2006), the needs of industrial companies in 1945 were almost eight times greater than the actual number of engineering graduates employed. This gap could not be filled by large-scale campaigns for the "nomination" of trustworthy people or Communist Party members for management positions, as the staff had to be trained. Moreover, surveys conducted several years before the transition to democracy and analyses covering the interwar period showed that the engineering profession enjoyed a level of prestige comparable to that of lawyers, doctors, and professors (Domański et al., 2010). An additional incentive for choosing majors was the relatively high salaries of engineers, which were concentrated in the upper wage brackets, even in comparison with other professionals with higher education. The most striking example was mining engineers, in the second half of the 1980s, nearly 50% of whom were in the highest-paid category (GUS, 1985b).

Political and economic pressures did not leave the issue of women's education untouched. The proportion of female graduates in technical fields never approached the level of men, even taking into account the fact that it was relatively high in the 1960s. The policy of including women in masculinised professions, introduced after the war and already somewhat reduced in that decade, can be linked to the relatively high proportion of women in technical faculties in the 1960s (Fidelis, 2015; Jarska, 2015). Although the campaign was primarily aimed at women with the lowest levels of formal education (or with no education at all), the idea of a kind of equality in access to "male" industries may also have permeated communities with higher levels of educational aspirations. Studying "male" fields of study may have meant a sort of emancipation for some women.

In fact, women who studied engineering and wanted to find a job that matched their qualifications faced many obstacles. According to data from the mid-1960s, 24% of women with engineering degrees were working in education, science, and culture. This was considerably more than the 14% of men with such degrees (Preiss-Zajdowa, 1967). Data from Statistics Poland show that in 1965 there were 13 women per 100 men employed as engineers, and as many as 78 per 100 in the humanities (GUS, 1968). There were also clear disparities in higher-ranking positions in the technical sector, e.g., at the beginning of the 1980s women accounted for only 12% of those employed in managerial jobs in the industry (GUS, 1985c).

In some majors the access of females was planned centrally. While women were allowed to study Pharmacy or Dentistry, their numbers were strictly regulated when it came to studying medicine. Since 1965, there was a quota that required an equal percentage of both genders to be admitted to medical studies. This rule created a sense of injustice among women, as they were in the vast majority of the applicants. Rigid admission rules meant that some male students who were admitted to university performed less well in entrance exams than women who were not admitted. This mechanism was only formally challenged as a result of a civil action brought by a female student who, despite her good results, was not admitted to university. In 1986, the Constitutional Tribunal declared that quotas for medical studies were incompatible with the existing Higher Education Act and the Constitution of the People's Republic of Poland, which guaranteed equal rights for both genders. The Ministry of Health and Social Welfare, which supervised medical schools, was obliged to repeal this rule (Constitutional Tribunal judgment of 3 March 1986 [Orzeczenie Trybunału Konstytucyjnego z dnia 3 marca 1986 r., Palestra 31/5[353], 69–77]). However, even after the removal of restrictions, there were still fewer women than men admitted to medical faculties (Jołkiewicz, 2011).

The proportions of women and men in the different fields of study before the political transformation in Poland did not differ significantly from the global trends. As in other countries, there was a feminisation of degrees in social sciences and humanities, with a high proportion of men in technical sciences. However, the concentration of women in the humanities and men in technical sciences increased the closer we got to the period of democratic transformation in Poland. It is possible that, in addition to changes in the structure of study programmes and the sudden increase in the availability of education in these fields, this may have been a result of the emergence of greater freedom in the shaping of one's own school biography after the 1990s. Research suggests that the diversification of higher education, combined with greater opportunities to express one's gender identity, tend to perpetuate traditional schooling choices. One manifestation of this trend is the lower level of feminisation of "male" degrees in more economically developed countries, a weaker tendency to compete among female and their limited desire to work in technology-related occupations, but more widespread belief in stereotypical attributes of women (Charles and Bradley, 2009). Other studies suggest that girls from the former East Germany performed better in maths tests and rated their skills in the subject higher than women from the former West Germany. The researchers also noted that the difference in test scores between boys and girls in the former Soviet bloc countries is smaller compared to other countries (Lippmann and Senik, 2018). However, this example does not support the thesis of the merits of socialism for equalising opportunities for women. Instead, it may suggest that there are certain socio-institutional conditions that create favourable circumstances for non-conventional – for a given gender – educational choices and those that do not favour these choices. The aforementioned researchers suggest that women's expectations of their future careers may be important. They indicate that they are less willing to invest in education when they expect a shorter working life and longer maternity-related breaks. Conversely, they will invest more where the support and childcare system is more extensive and enables a quicker return to work.

3.3. Changes in fields of study from 1997 to 2020

Let us now take a look at the popularity of fields of study from the time of education expansion until 2020. Up until around 2010, enrolment levels were rising steadily. However, not all fields of study attracted the same number of applicants. The choice in this respect is an individual decision that takes into account career prospects, chances of obtaining a degree, and the cost of the education. Table 3.5 compares the percentage of graduates in each group of fields of study in 1997 (when the number of students approached one million) and in 2020. This compilation, based on Statistics Poland data, has a relatively high, but not total, level of comparability between years (although it is not complete because of changes in the classification of fields of study). A further limitation when interpreting this data is the high degree of aggregation of the results, which makes it impossible to follow the changes in individual fields of study over time.

TABLE 3.5. SHARE OF GRADUATING STUDENTS BY FIELD IN 1997 AND 2020

Group of fields of study	**1997**	**2020***
pedagogy/education	26.5%	8.6%
humanities and arts	11.4%	8.7%
social sciences, journalism	8.3%	10.9%
business, administration, law	12.6%	24.1%
natural sciences	3.9%	4.1%
medical studies	3.7%	11.4%
engineering and technical studies	14.2%	21.4%
services	9.4%	10.8%
total	100	100

Source: GUS.

* The breakdown does not include interfaculty individual studies.

In the years covered by the analysis, a number of marked changes in the structure of HEI graduates can be observed. In 1997, the humanities, social studies and economics were particularly common among young people. At that time, more than a quarter of all graduates had a degree in education (almost 40,000 students left university with a degree in teacher training).

One of the reasons for the high interest in pedagogical studies in the 1990s was the development of non-public education, which to a large extent trained students in these fields. It was also characteristic that teacher training tended to take place at weekends and in the evenings, in both public and private universities. The extent of this phenomenon is evident in the fact that in 1997, only 21% of pedagogy graduates studied full-time, with the remainder graduating in another mode of study, mainly part-time (73% of all education graduates). By 2020, these proportions were almost reversed, with 70% of graduates being full-time and 30% part-time students (GUS, 2021b). In the business and administration group, fewer but still significant numbers of students graduated on a non-full-time basis. In the mid-1990s, 40% of those graduating from these programmes were studying full-time.

Given the changes in the economy, the evolution of study preferences is not surprising. Young people have been responding to the growing demand for skills in new technologies. Computer science, which was on the fringes of the higher education system in the early 1990s and attracted only a handful of candidates, has become one of the most popular fields of study in recent years. In 2021, 36,026 candidates, or 16% of all secondary school graduates, sought admission to this field of study (*Information on the results of admissions to degree programmes for the academic year 2021/2022 at universities under the supervision of the Minister of Education and Science*). In 2020, there was also a significant increase in the popularity of engineering and technical studies.

3.4. Graduates from 1997 to 2020

The dynamics of change in the choice of fields of study can be seen by looking at the educational choices of women and men. Between 1997 and 2020, social sciences, humanities, and education were consistently the most feminised fields of study in higher education (60–80% of female students). A high degree of feminisation can also be observed in natural sciences. In 2020, women accounted for 82% of students in biological sciences, 67% in physical and mathematical sciences, and 74% in environmental sciences (GUS, 2021b).

TABLE 3.6. PERCENTAGE OF GRADUATES BY GENDER AND FIELD IN 1997 AND 2020

	1997	2020*	1997	2020*
Group of fields of study	**Women**		**Men**	
business, administration, and law	21,3%	25,3%	25,3%	22,1%
medical studies	3,7%	14,7%	4%	5,8%
social sciences, journalism	8,5%	11,9%	8,4%	9,1%
engineering and technical studies	4,8%	11,9%	30,8%	37,3%
pedagogy/education	37,1%	11,7%	8,3%	3,3%
humanities	13,6%	10,2%	7,5%	6,4%
services	7%	9,7%	12%	12,7%
natural sciences	4%	4,6%	3,7%	3,3%
total	100	100	100	100

Source: GUS.

* The breakdown does not include interfaculty individual studies.
Services include fields of study in agriculture.

Changes in the distribution of women and men between fields of study are shown in Table 3.6. The decline in the popularity of pedagogy is one of the most significant changes for women. In 1997, 37% of all female graduates graduated in this field of study, and in 2020, this figure was down to 11%. Business, administration, and law have taken over the top spot, accounting for 25% of all female graduates in 2020, although the increase since 1997 has not been spectacular (more than 21%). The group of medical studies, including various fields related to health care and social welfare degree programmes has also risen in the ranking of the fields of study chosen by women, with almost 15% of all women choosing to study them in 2020, up from less than 4% in 1997. In the case of men, the changes in the distribution between the fields of study have not been as marked. Both in 1997 and more than two decades later, they were most likely to study engineering and technology. This category has increased by around 7 p.p. in recent years. There has been a decline in education programmes, which accounted for 8.3% of all male graduates in the mid-1990s, falling to 3.4% in 2020.

The data cited above shows that the underlying patterns of gender selection between fields of study have remained relatively constant over the years. The most striking feature has been the decline in the popularity of education courses in favour of technical/engineering studies, medicine, and social sciences. These shifts may reflect a generational change in strategy towards higher education. When the female graduates of 1997 completed their studies, those of 2020 were just coming into the world or taking their first steps in it. Females who graduated from higher education in the 1990s entered university during the initial period of liberalisation of higher education, while younger women commenced their studies when private education was marginal and public universities were lowering their entry criteria. Female students from the 1997 cohort started higher education during a period of high unemployment, while those in the 2020 cohort have had access to more job offers and non-traditional forms of employment. Women who started their studies around 2015 already had access to the rights guaranteed by Poland's membership of the European Union, foreign language learning as part of compulsory schooling, and unrestricted use of the internet. Younger women are also postponing deciding whether or not to start having children, and they rarely plan to have more than one child. The changes that have occurred in the socio-institutional environment have created different conditions for making educational choices compared to those faced by preceding cohorts. It is likely that personal interests and aspirations, rather than economic pressures, have determined the choices of the younger generations.

3.4.1. Mode of study and gender

The distribution of women and men in the various fields of study is an important issue as it is related to the value of qualifications obtained, the opportunities for employment, and salary. The choice of mode of study and type of HEI is also important for the same reasons. Higher education institutions increased the number and broadened the range of study modes other than full-time in order to absorb the growing numbers of students in a period of educational expansion. In addition to the traditional mode of study, students could choose between part-time, distance learning, and evening courses. Particularly large numbers of part-time places were offered by non-state institutions which, apart from regular fees, applied virtually no selection criteria for admission or introduced low entry requirements.

During the education boom of the mid-1990s, women accounted for 55% of all graduates in full-time studies, but there were significantly more among those studying in other modes – 74% in part-time studies, 64% in evening studies, and almost as many in distance learning programmes (GUS, 1998). Overall, 43% of female graduates who completed their studies in 1997 obtained a degree in full-time studies (compared to 64% of male graduates), while the remainder completed their studies in other modes. These differences were mainly due to the uncontrolled expansion of private schools with a pedagogical profile, which offered women the opportunity to obtain a diploma confirming their professional qualifications.

The marked decline in the private school sector in recent years has changed this pattern. In 2020, the share of full-time female and male students with a degree were almost equal – 65% and 66%, respectively. The gap between private and public universities has also narrowed. Of all female graduates, 72% graduated from public universities and of all male graduates, 76% graduated from public universities. These proportions continue to be strongly influenced by choosing to study teaching and business and administration-related degree programmes. Taking into account public and non-public universities, 40% of female students graduated from part-time programmes in 2020 (GUS, 2021b).

3.4.2. Women in engineering and IT majors

The interest of secondary school graduates in high-tech and engineering-related studies has increased significantly in recent years. This growth is a reflection of the global technological changes in almost all sectors of the economy. The importance of technical qualifications has moved beyond national education systems and has become the topic of a global debate. While no society can do without well-trained teachers, doctors, psychologists, and lorry drivers, the professions of the future include those related to data processing and management, building artificial intelligence, machine learning, and robotics.

In Poland, there has also been an increase in interest in these fields of study among young people. In the mid-1990s, graduates from the group of technological fields of study accounted for 13% of all university graduates, while two decades later they accounted for more than 20% (GUS 1998; 2021b). However, as with previous compilations based on official data, these facts should be interpreted with caution. It it mostly due to the changes in the classification of fields of study (including their merging into larger groups) and the increasing differentiation of education in a particular field of study at individual institutions (i.e. as far as study programme content is concerned). Despite these limitations, it is possible to make comparisons over shorter periods. Table 3.7 shows the percentages of all students in the groups of fields of study related to information and communication technology (ICT), engineering, industry and construction, education, and the humanities and arts.

Compared with the humanities and social sciences, there were fewer students in ICT-related degree programmes and only a handful in electronics--related fields of study. The former group of technology-related studies includes competencies related to database and network administration as well as computer use and application development. There was a relatively good representation in the group of fields of study related to engineering, industry, and construction. This is a fairly broad category, encompassing fields as diverse as architecture, manufacturing, and mechanical engineering. There was considerable interest among this group in engineering, with 8.6% of students graduating in 2019, and architecture and construction with 4%. Compared to 2013, the popularity of these fields changed minimally; at that time, students in the engineering subgroup accounted for 8.8%, while architecture and construction accounted for 5.1% of all students.

TABLE 3.7. PERCENTAGE OF TECHNOLOGY AND HUMANITIES FIELDS STUDENTS AMONG ALL STUDENTS IN 2013 AND 2019

Group of fields of study	2013	2019
information and communication technology	4%	5.9%
engineering, industry, construction	17.2%	15.4%
electronics and automation	ND	2.4%
education	12%	9.5%
humanities and arts	8.8%	9.5%

Source: Eurostat (EDUC_UOE_ENRT04).

Let us now look at the gender structure of students and graduates in ICT-related fields of study. Again, the nature of the official data, which aggregates individual fields of study into larger groups that sometimes differ significantly in terms of important gender characteristics (such as the proportion of academic mathematical knowledge or the type of professional work), is an obstacle to tracing changes over time.

However, some information about women's participation in ICT can be gleaned from official records. In Poland in the early 1980s, computer scientists were educated in at least two fields of study. The first was computer science, which was part of the mathematical specialisations at universities, and the second was computer science as part of the engineering specialisations at technical universities. In both cases, these fields attracted a handful of students. In 1980, 0.6% of all graduates completed this study programme (GUS, 1982b). Women represented 35% of computer science graduates at technical universities and 56% at universities. In 1985, they accounted for 0.74% of all graduates, while the share of female computer science graduates at technical universities was 49% and 44% at universities. A change can be seen in the structure of graduates in 1995. The proportion of female graduates in computer science was lower (27%), while the proportion of women graduating in computer science and econometrics was significantly higher (53%), (GUS, 1985d). At that time, technical universities were already educating more computer science students than in previous years (in 1995, a total of 519 graduates), of which only 20% were women (GUS, 1995). This trend continued in the following years. In 1997, computer science education was offered in computer science and computer science and econometrics degree programmes. Technical universities were offering more places in this respect. In 1997, 16% of the 750 computer science graduates from technical universities were women. In contrast, more women studied computer science and computer science and econometrics at universities. In 1997, women accounted for 39% of graduates in the former and 50% in the latter fields of study (GUS, 1998).

The data presented here do not allow for the formulation of strong hypotheses on gender selection in computer sciences, but it is possible to note an emerging gender imbalance in computer science programmes taught at different types of universities. The proportion of female students has been decreasing at technical universities, while it has remained relatively high at classic universities. It can be hypothesised that this was partly related to the different study programmes. In the former, the mathematical knowledge component was more prominent, while in the latter, the aspect of computer work was more developed. Social factors such as the of studying in a male-dominated environment, may also have reinforced these choices. In the mid-1990s, female graduates from technical universities accounted for one-fifth of all students, And in many fields of study, such as metallurgy and robotics, the proportion of women did not exceed 5% (GUS, 1998). The perception that one would be in a minority as a result of one's choice of a degree programme may have had a discouraging effect even on women who had sufficient skills for technical studies.

At the beginning of the 21st century, the share of graduates with a degree in ICT started to grow quickly: in 2001, they accounted for 1.3% of all graduates, and by 2004 they had reached 3.4%. Since 2014, when the GUS identified the ICT group (which includes the fields of study in computer operating, programming, and network and database administration), there has been a slight increase in the proportion of women in education in this field, but it was still significantly lower than for men. The share of female students in these fields of study (as a share of the total female population in higher education) increased from 0.37% to 1.13%, while the share of male students increased from 5.3% to 10.2% in 2020.

TABLE 3.8. STUDENTS IN ICT FIELDS IN 2015 AND 2020

	The share of women among ICT students	The share of female ICT students in the total female student population	The share of male ICT students in the total male student population
2015	11.5%	0.37%	5.3%
2020	15.8%	1.13%	10.22%

Source: GUS, 2015a; 2021b.

Other analyses also show that there has been a slow but steady increase in the proportion of women in IT studies (Fundacja Edukacyjna „Perspektywy", 2019; 2021) and that they are also more likely to continue their studies as part of the second cycle of higher education. In 2020, men represented 84% of all first-cycle IT students, while in the second cycle, their share decreased to 77% (Fundacja Edukacyjna „Perspektywy", 2020). It is also worth noting that women were significantly more likely to choose to study IT at a higher education institution in a social sciences faculty or at a university. There was also a big difference in female participation between business universities, where they accounted for 29% of IT students in 2020, and technical universities, where they accounted for only 15% (Fundacja Edukacyjna „Perspektywy", 2021). This suggests that the growing supply of tertiary IT education may encourage further gender segregation.

In terms of preferences within the broader category of technical education, it can be seen that women are generally more likely to have a degree in construction and architecture as well as in manufacturing and processing, than in computer science. Table 3.9 shows the share of female and male graduates in engineering, manufacturing, and construction of the total number of graduates. In 2020, the largest difference was in the engineering and technology subgroup, which comprised 17.9% of all male graduates compared to 4.2% of all female graduates.

TABLE 3.9. FEMALE AND MALE GRADUATES OF TECHNOLOGY SUB-GROUPS AMONG ALL GRADUATES IN 2020

	Female	Male	Percentage of female students in the total number of graduates
Technology, industry, construction	10,3%	25,7%	40,2%
sub-groups (fields of study):			
engineering and technology	4,2%	17,9%	28,3%
manufacturing and processing	2,2%	2,5%	58,5%
architecture and construction	3,5%	4,9%	55,3%

Source: GUS, 2021b.

Individual technical fields of study differ quite significantly in terms of the share of female students. In 2021, they accounted for 5.9% of the total number of students in electrical engineering, 7.4% in automation and robotics and 8.2% in mechanical engineering and mechanics. Compared to 2019, slight changes can be seen here – at that time, the percentage of women in these study programmes was respectively: 8,4%, 6,4% i 8,7%. In 2021, construction, where women accounted for 36% of all students, architecture and urban planning (71%) and production management (59.9%), were more popular with representatives of this gender within the group of engineering majors (bit.ly/48BRHCb).

Here, it is worth considering why the dynamics of women's participation in computer sciences studies in Poland have changed. In 1996, the specialist journal *Informatyka* wrote about the huge demand for network administrators and programmers, whose number did not meet the needs of the rapidly growing labour market in this sector (Karwacka, 1996). At the same time, even by the most conservative estimates, the representation of women in IT faculties during this period, although not in decline compared to previous years, did not increase either. Before the economic transition in the 1990s, the proportion of women in this field of study was relatively high, but in the early 1990s, when the role of this field and the entire sector began to increase, the proportion of women studying computer science at technical universities declined. What caused this change?

Several hypotheses can be drawn from the research on women in the technology sector in the USA (Margolis and Fisher, 2002). During the period of its intense growth spanning from 1965 to 1985, the number of women in computer science departments was increasing steadily. A growing number of them were working in IT companies. The researchers point out, however, that from the mid-1980s onwards, this trend slowed down and the proportion of women in computer science departments at American universities began to decline. This coincided with the spread of computers in companies and institutions but also in the homes of the American middle class. Here, however, the new equipment was mostly in the hands of men. Jane Margolis and Allan Fisher found that personal computers were purchased primarily with adolescent sons in mind and tended to end up in their rooms. Girls growing up in the 1980s were less likely to get them for themselves and could only use them with their brothers' permission (Margolis and Fisher, 2002).

Women had limited possibility to develop digital skills on their own, freely explore the functionalities of the device, make mistakes and creatively fix them because they did not have unlimited access to a computer (even if it was a device with modest capabilities compared to today's computers). Instead, such opportunities were available to men, mostly from families of high social status. In the public mind, computers very quickly became associated specifically with men, who themselves became the gatekeepers of the knowledge and skills of this emerging field of science. The initial functionality of computers for individual consumers accelerated this process. In the 1980s, they were still exclusive toys rather than devices to be used for work or for programming. Boys, however, immediately swallowed the bait thrown by game developers and came to dominate the gaming sector, honing their digital skills in the process.

Computers have been an integral part of men's interests and have had a notable impact on the public's perception of their digital skills. Through the popularisation of the image of a nerd, i.e., a young man who is passionate about computers and committed to developing his digital skills, the belief that boys are highly competent in this area has entered the popular imagination. The way in which programmers have been recruited into the profession has helped to perpetuate this image. At the time of the first computers, programmers were at the bottom of the hierarchy of those centred around the new technology. By the 1960s, American employers were hungry for them. As there were no systematic staff training schemes in universities and schools, self-learners were able to compete for jobs in new industries. This reinforced the belief that talent outweighed formal education in programming. There was also an additional criterion that was assumed to identify effective programmers. Namely, it was believed that people who did not like to interact with the environment and who were more involved with objects than with people were more competent (Abbate, 2012). A special test has been developed to identify men who are particularly antisocial. The growth of the industry and its profits coincided with the development of the typical image of a geek programmer, who compensates for his social deficits with outstanding programming skills.

These processes followed a similar pattern in Poland. The belief that technological progress in many areas of life would be achieved by "electronic brains" was already well established in academic and non-academic circles in the 1970s. However, as in the United States, young people from more affluent families had no intention of using computers for programming, but rather for play (Tadeusiewicz, 1987). As a result, computers were more likely to be in the hands of young and adult men. A vestige of this regularity remains in the youth journal *Bajtek*, which appeared in the mid-eighties and featured interviews with professionals, computer codes, experiences, and advice. The contents of *Bajtek* were not directly gender-specific, but many communication levels corresponded to the stereotypical interests of men and boys. For example, readers were encouraged to share their experiences of playing games on Atari computers, which were mainly about boxing, magicians, and controlling a space. The overwhelming majority of the codes that appeared in the magazine were written by men, and it was they who gave the readers technical advice and revealed IT tricks. Men were interviewed about the fledgling IT market in Poland, the challenges facing the industry, and were positioned as experts in implementing new technologies in various fields such as medicine and arts. When the editors of the *Komputer* monthly surveyed readers in the mid-1980s, they found that 95% of its readers were men around 20 years old (Kolasa, 1999).

The new discipline went through all the typical stages of professionalisation and institutionalisation. The academic community recognised the need for a systemic education in computer science, although there were suggestions and signals that the new study programme should be aimed mainly at men (Tadeusiewicz, 1987).

Gender segmentation processes in the IT industry were also visible in the labour market. As in the United States, the new sector in Poland did not have established recruitment channels at the beginning, so people with very different professional experience were accepted to work in IT companies. A survey carried out in 1976 at the computer company shows how different the qualification profile of staff employed in IT positions was in this respect. Men with secondary or tertiary education in computer science or technology were several times more likely than women to be employed there. Among women with tertiary education, those with degrees in economics and mathematics predominated (Ożóg-Skolimowska, 1976). This may mean that men entering the emerging IT occupations (or at least some of them) had a more appropriate background in computers and were, therefore, assigned to more specialised tasks. Women had to retrain and adapt their skills to the requirements of the job. A problem for them was the periodic interruptions caused by maternity leave, sometimes resulting in many years of absence (Ożóg-Skolimowska, 1976), which effectively limited their ability to adapt to a rapidly developing industry.

The increasing importance of computers, which began to replace humans in advanced tasks, may also have influenced the position of women in IT occupations. Elżbieta Karwacka (1996), writing in the *Informatyka* journal, noted that in offices and companies, these devices were initially used in finance and accounting departments. This may be one of the reasons why, in the late 1970s and 1980s, women were more likely to choose computer science and business studies at universities (see previous section) than computer science at technical universities. Over time, however, as computers have become more advanced and more widely used, the responsibility for programming has been transferred to specialised units within the organisations. The acceleration of these processes was the result of the liberalisation of the economy in the 1990s. The demand for IT jobs grew. However, there were not enough IT professionals, and IT training was on the fringes of the education system. The private sector, which compensated for the lack of job stability compared to the public sector by offering salaries that were many times higher, became a natural working environment for people with IT skills.

The analyses in this chapter paint a picture of the social evolution of women's position in computing. As advances in processor miniaturisation brought computers into offices and homes on a larger scale, the devices quickly found themselves in men's orbit. During the transition period when computer systems began to be implemented in companies, the advantage in technical and engineering training that men had gained in the 1970s and 1980s became a springboard for some of them to move into specialised positions in the workplace, and further areas of life were subject to digitisation.

3.5. Summary

Given the persistence of social mechanisms, the increase in women's participation in higher education is a rather rare case of a reversal of the stratification order. At the beginning of the 20th century, women made up around 10% of students; 100 years later, they accounted for almost 60%. The reasons for this phenomenon lie partly in the historical changes in the social and economic situation of women over the past century. Claudia Goldin (2006), among others, pointed this out when she described the lives of three generations of American women in the 20th century. Women born in the early 20th century, who worked mainly in industry, in family-owned businesses, or were employed as servants, were not required to be formally educated and were often illiterate. This period was also characterised by women ceasing to work after marriage and becoming mothers. The lack of a stable, institutional form of child care and the prevalence of traditionalism in many social classes contributed to the female school opportunities. The situation began to change for the generation of women born in the 1930s and a little later. At that time, women's paid work was becoming socially accepted, as was the question of their contribution to the household income. Women were encouraged to pursue secondary education because of the growing demand for office and clerical workers. Working American married women born between 1950 and 1970 had higher levels of education than married women not in work. There were revolutionary changes in the empowerment of women and their ability to shape their own futures. Claudia Goldin (2006) points out that more and more young American women are planning their lives around working and postponing motherhood until later on. Having clear priorities and defined career paths has been an important incentive for further study at tertiary level.

In Poland, these changes have followed a similar pattern. In the mid-1970s, half of all students were women, and there was a gradual increase in their dominance over men among university graduates. The gap in higher education choices widened in the 1990s and at the turn of the 21st century when access to tertiary education became easier than in the past. Women were more consistent than men in their post-secondary education choices and less likely to drop out before graduating. This may have contributed to the widening of the gender gap in education more than the threshold for university entry.

At the same time, the proportion of men with tertiary education also increased, but not as dynamically as for women. On the other hand, shifts in the horizontal dimension, i.e., between fields of study, were less pronounced. In the case of men, a relatively stable preference for engineering and technical studies was observed, which became even stronger among the population born in the late 1990s. For women, these changes have been much slower and less consistent.

A number of questions about the individual reasons for the differences in the educational structure between men and women are raised based on the comparison of educational attainment between men and women. Why have women made different educational choices, even though they lived in the same social, political, and economic environment as men? Does this have to do with different goals, interests, and economic aspirations? What role do cultural norms about women and men have in the perpetuation of these differences? These questions are explored in the next chapter.

4

Economic background to women’s and men’s schooling choices

From an economic perspective, education is a form of investment. It is assumed that the skills and knowledge acquired at school will lead to higher wages, a better job, and a lower risk of unemployment in the future (Becker, 1994). These benefits should accrue even after deducting the direct and indirect costs associated with education. In its original formulation, human capital theory also contains a number of distinctive assumptions about the way in which people approach various aspects of life. It is assumed that individuals strive to obtain the greatest possible benefits from the resources and actions that are available in given circumstances. The understanding of human rationality proposed by neoclassical economics has been the subject of repeated criticism both in economics and other fields (Kahneman and Tversky, 2019). Proponents of the rational theory of human behaviour have been criticised, among other things, of being too "economic" in their account of human motivations and of excluding from the decision-making process factors other than rational calculation (Tan, 2014). These include, but are not limited to: intuition, the subjective perception of the situation, peer pressure, or the selection of information (Kahneman and Tversky, 2019). Factors such as individual interests, peer group choices, parental and social environment, as well as gender-related attitutes, play a significant role in choices related to education.

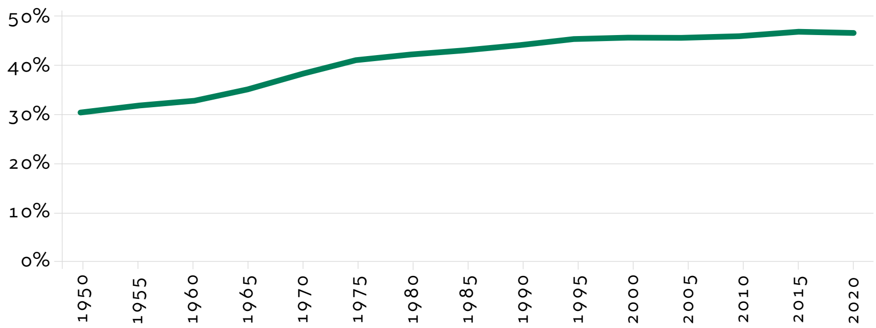
Less controversial than the concept of rationality is the relationship between one's educational attainment and their occupation and salary (Belley and Lochner, 2007). Higher educational attainment is associated with higher pay, higher position in the organisational hierarchy, greater ability to perform more complex job tasks, and reduced risk of unemployment (Oreopoulos and Petronijevic, 2013; Chłoń-Domińczak, 2019).

So why, in light of these benefits, have men and women made different choices concerning higher education in recent decades? Is the balance between the costs and benefits of higher education sufficiently different to explain the gender gap in educational attainment? This chapter addresses these questions and focuses on the economic consequences of educational decisions by both genders. An analysis of a range of data suggests that women may pursue higher education because they are less well-placed in labour markets, are at higher risk of unemployment, experience more recesses, and earn less than men. A university degree is a hedge for women, protecting them from the consequences of their inferior labour market position.

4.1. Employment of women before the economic transition in Poland

The growing popularity of formal education went hand in hand with an increase in the proportion of women in the labour force. Their situation in the labour market prior to the economic transition in Poland was characterised by at least three elements typical of Eastern Bloc countries. The first was the rapid growth in the share of women in the labour force; in 1950, women accounted for 30% of the total labour force; a decade later, they formed 45% of the labour force. In the following years, the upward trend has slowed down and stayed slightly below 50% (GUS, 2015b; 2021c).

FIGURE 4.1. WOMEN AS A PERCENTAGE OF THE LABOUR FORCE 1950–2020



Source: GUS, 2015; 2021c.

The increase in female employment rates was even more marked when the working population was restricted to young people. In 1960, the ratio describing the number of women in employment aged 25–29 was 63 (per 100), in 1970 it rose to 75 and, after rising to 79 in 1974, at the end of the 1970s it fell back to the level from the beginning of the decade. This fluctuation could reflect a specific trend that younger women are more "susceptible" to the negative effects of an economic crisis. Women, especially young married women with less seniority, are most likely to be excluded from the labour market in times of economic turmoil when the number of available jobs falls. This was the case during the crisis of the 1970s. Between 1974 and 1978, the share of women aged 25–29 in the labour force fell by 4.6 p.p., compared with only 0.9 p.p. for men. For other age categories, this decline was lower (reaching 1 p.p.), (GUS, 1968; 1985c).

A second characteristic of the employment structure, although not unique to the pre-transition period, was the high degree of gender segmentation. Women were particularly concentrated in sectors such as education, health care, and social work as well as in the services, financial, commercial, and cultural sestors. In the first half of the 1980s, women accounted for 83% of the labour force in finance and insurance, 80% in health care, and 75% in trade and education (GUS, 1985c). Young women, who were more likely to have completed secondary education than their mothers' generation, found jobs in these sectors. As already mentioned in the previous chapter, public administration was the sector particularly attractive to young women at the end of the 1960s: 71% of its female employees were aged 18–39, compared with 41% of its male employees in this age group. The situation was similar in the financial sector, where 74% of all female employees were in this age group (compared to 44% of men). Young women were also more attracted to trade and transport than young men. However, these differences did not exist in industry and construction, where the employment share of both genders was balanced (GUS, 1972). This may be an indication that jobs in administration and some service sectors were increasingly attractive to younger generations of women and less so to men, who were more likely to be employed in sectors traditionally associated with their gender. In the mid-1970s and 1980s, as employment growth slowed down, the average age of women employed in many sectors continued to be lower than that of men. In education, the average age was 36, compared with 40 for men, and in finance 33 and 42, respectively (GUS, 1972; 1987).

The wage gap was a third distinctive factor affecting women's economic situation under socialism. In the early 1970s, their average salary was 30% of that of men, and this inequality was evident in all sectors and occupations. In 1985, 7.4% of working women and 36% of men were in the three highest salary categories (out of 11 identified by Statistics Poland). The gap was particularly wide in industry, with 9.4% of women compared to 45% of men. In the three groups with the lowest earnings in this sector, the share for genders was 4.4% and 0.5% respectively. In construction, the earnings disproportion was similar, but here even more women were in the lowest pay distribution – 8.9% (and only 1.8% of men). In the distributive trades, 16.6% of men and 4.9% of women were in the highest pay grades, and an even greater difference could be observed in the transport and forestry sectors. In the women-dominated sectors, the differences were smaller, but even there men had an advantage. In education and training, 18% of men were in the highest earnings group, compared with 6.3% of women. The situation was similar in culture and the arts (GUS, 1987).

There was an inverse relationship between the average salary and the degree of feminisation of the sectors. Employees in health and education earned the lowest salaries, while those sectors with the lowest representation of women, i.e., construction, science and technology, industry and transport, had relatively higher salaries. The Statistics Poland's data on wage groups illustrate the extent of these differences. In the mid-1980s, the highest average wages were recorded in industry and construction. In education and training, they formed about 74% of the highest wages, and in health care, they were about 68%. The pay gap between these sectors is even more striking when looking at the salaries of managers. In administration, they earned on average 78% of what their counterparts in industry earned. In health, the difference was 74%, while in education managers received around 58% of these amounts. At the same time, it should be emphasised that professional and managerial positions in sectors such as health, administration, education, and finance were much more likely to be occupied by women than in industry, construction, and transport (GUS, 1987).

The official data does not allow an analysis of how other factors, such as position or job experience, have influenced salaries. However, all available information and survey results indicate that women earned less than men, were concentrated in lower and middle positions, and had limited opportunities for promotion. At the same time, women's educational attainment has been steadily increasing and, as the analyses presented in the previous chapter show, in each successive generation, women have been more likely to have completed secondary and tertiary education. Therefore, the question of whether the economic benefits they have gained have provided the impetus for these choices seems legitimate.

Economic background to women's education

An examination of available data suggests that women who completed secondary education were better off economically than those who left education early. This is illustrated, among other things, by data on the structure of household incomes. In the mid-1960s, 62% of women with tertiary education were in the top two of six wage groups, compared with less than 10% of women with secondary education and 2.5% with primary education (GUS, 1968). For men, the pattern was similar, i.e., the level of earnings also increased with educational attainment, but the differences between men and women within educational categories were significant. One in five men with only primary education fell into the highest earnings category, compared with 0.4% of women. In contrast, more than 50% of women with primary education and only 8.1% of men were in the lowest earnings category. Among those with secondary education, 60.4% of men and 9.8% of women were in the highest earnings category. In the group with tertiary education, the proportions were 73% and 40%, respectively.

The data clearly shows that for women, higher educational attainment had a positive impact on their wages, whereas a lack of education exposed them more often to lower pay grades than that of men. The situation was particularly bad for women with primary education, as advancement in the wage hierarchy was facilitated by the completion of secondary education and, to a greater extent, tertiary education. This trend continued in the following years. GUS records from the mid-1970s show that 96% of women with a university degree qualified for the highest wage category. This compares to 70% with secondary education, 32% with primary education, and 41% with basic vocational education (GUS, 1975).

It is likely that if important variables such as professional experience and industry had been taken into account, the wage structure would have been somewhat different. A case study by Janina Waluk (1965), based on two workplaces in Warsaw with different proportions of women in the workforce, sheds some light on this issue. Looking at the wage structure in a woman-dominated company, the researcher showed that among male employees, there was a positive, meritocratic relationship between the salary received and education; the highest salaries were received by those with higher and secondary education. In the case of women, this was less true, and higher education was less likely to lead to as high an increase in earnings. The researcher linked the lack of an adequate bonus for women's higher education, similar to that among men, to differences in professional experience, and effectively to their age. Women who were employed for the longest period were more likely to have lower levels of education, while those who achieved higher levels of education were more likely to be employed for the shortest period. This observation may be an indication of the growing impact of higher education on the wage level of younger female employees and of pay discrimination against older women who have not reached this level of education. No information is available on how much the duration of employment affected the wages of men. Waluk (1965) found another typical pattern in her case study; irrespective of the level of education, men were paid more than women working in the same positions. A similar pattern was also found in a company with a low proportion of women in the workforce. However, without more detailed information, it is difficult to assess the impact of women's higher levels of education on their bonuses in relation to other factors affecting pay.

The available data for the period before the economic transition in Poland is sparse and reports only on selected aspects of the economic standing of women and men; however, based on data, it can be hypothesised that having a university degree was not associated with a similar wage premium for women as it is for men. Education was probably a weaker differentiator of women's wages. It is also likely that the interaction of lower education and age worked against them, as older female workers, without any qualifications, were employed in the simplest and lowest-paid jobs.

Formal tertiary education did, however, open up opportunities for women that they would not have had without having completed the appropriate level of education. A secondary school leaving certificate and, above all, a university degree gave the younger female generation a real chance of obtaining a white-collar job at the middle level of an organisational hierarchy. A higher level of education reduced the need to do manual work in unfavourable social conditions that older, less educated female workers were forced to accept.

Studies of the gender and educational structure of job seekers provide further evidence for the above hypothesis. Data presented by Zofia Dach (1976) show that among jobseekers in 1960, 76% of women had no qualifications compared to 46% of men. A decade later, when those who had been educated after the World War II began to seek employment, the gap had narrowed somewhat, but it was still significant: 66% of women and 31% of men lacked relevant qualifications. The poor education of the oldest women, who had either the lowest level of education or no education at all, was the main reason for this result. Without any qualifications, it was more difficult for them to find a job than it was for men.

The educational progression of women and the professional deactivation of the oldest and least educated female workers have been factors contributing to the gradual convergence of the educational structure of men and women in the labour market. Table 4.1 shows that at the end of the 1970s, the largest proportion of the unemployed received the primary education, with a relative majority of women. By the end of the 1980's, the level of education of the unemployed was already comparable between men and women. As school enrolment rates increased, so did the educational attainment level of the unemployed. In addition, the share of unemployed women with tertiary education increased (more so than men). It is also worth noting that the unemployed – regardless of gender and decade – were mainly those with lower levels of education. It can, therefore, be concluded that education had a positive impact on the employment situation, even if the economic system did not operate on a fully meritocratic basis.

TABLE 4.1. EDUCATION OF NON-WORKING WOMEN AND MEN AGED 18–40 IN 1978 AND 1988

Level of education	Year			
	1978		1988	
	Women	Men	Women	Men
primary	47.2%	37.3%	25.9%	27%
basic vocational	23.9%	33.1%	35.6%	39.6%
secondary	27.4%	27.7%	33.3%	30.3%
higher and incomplete higher	1.5%	1.9%	5.2%	3.1%
total	100	100	100	100

Source: IPUMS International (bit.ly/46fxAbl), results of the national censuses of 1979 and 1988.

Prior to 1989, women with higher education had an advantage in terms of wage compared to women with no qualifications. Completing education after primary school or lacking education whatsoever were factors that increased the risk of falling into the lowest wage group or made finding work more difficult. Changes in the structure of employment gave women access to relatively low-paid jobs, with a little chance of promotion. During the period of rising school enrolments, there were fewer jobs in education, administration, and health care than in industry, but their number increased faster. In 1950, 41% of all employees worked in industry, 5.2% in education, and 2.9% in the health sector. Less than 20 years later, in 1968, industry employed 42% of the workforce, but 7.6% were employed in education and 4.6% in health care (GUS, 1970). Partly as a result of these changes, caused by the need to adapt to white-collar jobs, the number of working women with tertiary education also grew faster than that of men – seven times faster between 1973 and 1983, compared to five times for men. In the early 1980s, the number of employed women with higher education exceeded that of men (GUS, 1987). Men largely continued to find employment as skilled or unskilled workers in various industries and manufacturing. These differences in employment patterns pushed men and women towards different educational paths – women towards general education, men towards vocational education.

4.2. Women's labour market position after 1989

Systemic transformation in Poland, i.e. the transition from a socialist to a capitalist economy, was accompanied by rapid changes in the labour market. In the first few years after 1989, this was manifested in a high level of unemployment, growing social inequalities and ever-widening poverty. New jobs were created in the service sector (mainly in the rapidly growing private sector), while jobs in industry and agriculture declined. In the public sector, the state has retreated from being a relatively stable and predictable employer. The same happened in the area of welfare benefits. The change in the role of the state has shifted most of the responsibility for ensuring the economic well-being onto the members of the household. Many families were affected by the reduction in social transfers and the limited availability of institutional forms of care for the youngest children. Due to the commercialisation of services related to the upkeep of the family, education, and the upbringing of children, household budgets have had to cope with increased expenditure on day-to-day living. These developments have increased the gap between the economic burden on families and their ability to meet the growing costs of living.

All Poles were affected by these changes, but the impact on women and men was different due to the biological and social roles they played. After the political transformation, women were more likely to be unemployed, had more difficulties in returning to the labour market, and experienced a deterioration in their employment conditions (Kotowska et al., 2008). They were also less likely than men to be economically active. This trend, which is particularly relevant for young people, was already present before the systemic transformation (Matysiak et al., 2010), and after 1989 it was additionally compounded by problems with entering the labour market, which functioned according to the new rules.

These problems were particularly acute for young women who were taking up their first ever job and at the same time had a family or were entering the typical age for starting one. These conditions worked to their disadvantage. Employers were reluctant to hire them on the grounds that they would be restricted by their motherhood responsibilities and would not be as effective staff members as men because of their roles as mothers and wives. These forms of exclusion have influenced, among other things, the higher level of unemployment among women. In 2000, 37% of 15–24 year old females were unemployed (the average for the 27 EU countries was 21%). In the case of young men, the average was 33% in Poland and 18% in the EU (*Eurostat. Unemployment by gender and age* [1992–2020]).

Motherhood significantly weakened women's labour market position. This problem affected both mothers with younger children, who withdrew almost completely from the labour market, and mothers with children of school and pre-school age, who wished to return to work after a recess. The transfer to households of some of the costs of institutional care in public nurseries and the early years of primary school did not help to overcome these difficulties. The shrinking of the network of nurseries and kindergartens further perpetuated the popular model in Poland of childcare provided by family members and reinforced the negative image of childcare institutions in the eyes of parents.

Worsening working conditions and the rising cost of living have contributed to the adoption of specific adaptation strategies, both in terms of material demands and long-term, lifelong decisions, such as marriage or motherhood. The rates of both categories have been changing steadily in recent decades. The fertility rate fell from 1.97 in 1995 to 1.36 in 2000 and 1.33 in 2021. At the same time, the median age of women giving birth to their first child in Poland has increased: in the mid-1990s they became mothers at 22.8, five years later – at 23.7, while in 2021 – at 28.7. Similarly, the average age of women giving birth was rising during this period (bit.ly/46mEACS). These values are confirmed by the procreation plans of young Polish women. Surveys show that in all age categories, the share of those who plan to have offspring in the next few years is decreasing, while the percentage of women who do not consider motherhood in their life plans at all is increasing (CBOS, 2023).

Interpreting these trends, as well as related declines in the number of marriages and increased divorce rates, researchers (Kotowska et al., 2008) suggest that this reflects a specific form of adjustment to the rules of the capitalist labour market. The model of permanent employment, which offers relative stability, is increasingly being replaced by other short-term contacts or employment without a contract, which are associated with uncertainty, risk and lower predictability (Kiersztyn, 2017). The pattern of entering adulthood by starting work right after graduation is also becoming increasingly rare. These areas are more often intertwined – neither education is an obstacle for young people to enter employment, nor does work preclude the possibility of simultaneous education. For women, however, additional problems arise. The lack of ready-made formulas for transitioning from education to work and the instability of employment further exacerbate the negative impact of motherhood on their work, limiting opportunities for advancement after a childcare break and decreasing employment opportunities with each subsequent child (Matysiak, 2009).

At the same time, the gap between women's career aspirations and their ability to achieve them with full maternal burdens has been widening. In addition to structural difficulties, the prospect of the double burden of work and domestic responsibilities that usually fell on their shoulders may have influenced their educational and professional decisions. Analyses by Danuta Duch-Krzysztoszek and Anna Titkow (2006), based on data from the European Social Survey, show that almost 30% of men were involved in little or no housework. This was reflected in the extra time that women had to devote to their children and the home when they returned from work. Significantly, however, this area of life was also related to education: less educated women were more likely to accept the traditional role of wife and mother, and to take on more domestic responsibilities than those with higher education. It is also possible that this aspect, related to emancipation at the household level, as well as the prospect of taking additional domestic burdens off their shoulders, motivated women to invest more in education in the 1990s and after 2000.

Labour market position and education

The economic transition of the early 1990s brought with it the promise of careers based on meritocratic factors, such as knowledge, and skills. Pursuing higher education has not only enabled people to survive the most difficult period of economic upheaval in the 1990s but also offered them the chance to secure a career. These hopes were fulfilled, at least in the initial period of transition, when the premium for a university degree was higher than before 1990. Studies show that in the late 1980s, a person with a university degree earned on average 19% more than a person with a vocational school diploma, and by 1993 the difference had grown to 50%. In particular, university graduates employed in the private sector benefited greatly, with the pay gap compared to those trained in the VET sector reaching 90% (Rutkowski, 1996a; 1996b). Higher education offered great advantages until the mid-1990s. In subsequent years, its benefits became smaller (Szczepanik, 2016; Strawinski et al., 2018). Tomasz Gajderowicz, Gabriela Grotkowska, and Leszek Wincenciak (2012) analysing the trends in the first decade of the 21st century showed that the premium for tertiary education declined from 27–34% in the second half of the 1990s to around 15% in 2009. However, even after this decrease, the benefits of having higher education were greater than the premium for other levels of education, ranging from 20 to 40% for a first-cycle degree and from 50 to 60% for a second-cycle degree (Rocki, 2021).

A number of studies carried out in recent years have shown that women receive a higher education premium than men (Herbst, 2015; Wincenciak, 2017; Myck et al., 2009). Michal Myck (2009) documented that in the first decade of the 21st century, the economic benefits for women ranged from 8% to 13%, compared to 6.7–9.7% for men. A later study by Leszek Wincenciak (2017), which took into account the length of tertiary education, showed that the premium was lower for women than for men at the first-degree level, but this relationship was reversed at the second-degree level. Wincenciak also found that men who did not study earned more than women who did. Michael P. Keane and Eswar S. Prasad (2006), on the other hand, found that in Poland, before the transition, women received a larger premium for having tertiary and secondary education, whereas since 1996, the trend has reversed and it is men who have made relatively larger gains. In turn, other studies have shown similar gains for both genders (Adamczyk and Jarecki, 2008; Roszkowska and Majchrowska, 2014). Sylwia Roszkowska and Aleksandra Majchrowska (2014) confirmed the existence of a gender wage gap, but it was not related to the secondary and higher education premium, which between 2004 and 2010 was similar for each gender.

The evidence on higher returns to education in other countries is also inconclusive. Some international studies suggest that the education premium is higher for women than for men in developing countries, but this relationship does not hold in stable and prosperous economies (Dougherty, 2003; Psacharopoulos and Patrinos, 2004).

The lack of clear evidence that women receive a higher financial premium for education than men suggests that economic benefits may not be the only reason for the higher education gap. Women do earn more after graduation than those who completed schooling earlier, but a similar pattern exists for men. Other studies suggest that women with low levels of education have been "penalised". Their average salaries were lower than those of men, but the gap varied by level of education. Krzysztof Kompa and Dorota Witkowska (2018) showed that in the period from 2001 and 2009, women with higher education earned on average 83% of the amount earned by men, and the gap increased with lower levels of education, reaching 50% at the basic vocational school level.

Salary is one of the indicators most commonly used by economists to assess the cost-effectiveness of educational choices, but it overlooks other dimensions of labour market participation such as employability, risk of unemployment, and career opportunities. When these factors are taken into consideration, the position of women is less favourable than that of men. Women are more likely to be unemployed and face greater barriers to professional entry, more often hit a "glass ceiling" (difficulties in accessing high positions) and experience the "sticky floor" (lack of opportunities for professional advancement). These phenomena have a variety of causes. Some theories point to structural factors linked to women's place in the labour market, like, for example, women concentrated in low-paying sectors, their employment in lower-status jobs (Kompa and Witkowska, 2018; Combet and Oesch, 2019), and working fewer hours. Other theories explaining the more difficult situation of women in the labour market point to mechanisms of soft discrimination, manifested in employers' preferences for the hiring and promotion of male employees. Women may also be disadvantaged by having to care for children (Yu and Hara, 2021). The term "motherhood penalty" is used to describe the situation, which refers to the costs women incur as a result of interruptions in work due to their role as mothers, or as a result of having to choose jobs, positions, and forms of employment that allow them to combine their work responsibilities with child-rearing. Research on a Polish sample suggests that it is more difficult for mothers to return to the labour market after a period of unemployment, which means that they have lower employment opportunities than men and childless women (Wysieńska-Di Carlo and Karpiński, 2020). Mothers also earn less than women without children. In contrast, some studies found that men who become fathers receive a financial bonus associated with employer favouritism, an increase in their working hours, and greater determination in requesting a pay raise (Boye et al., 2017; Yu and Hara, 2021). Also some studies show that factors such as remaining married or being a biological father are becoming an advantage in determining men's salaries, which are perceived by employers as evidence of greater involvement in the child-rearing process (Killewald, 2013).

It is worth noting that the scale of "motherhood penalty" can be at least partly reduced through social policy mechanisms to support women returning to the labour market. Research indicates that the size of the "penalty" for women depends, inter alia, on national social policies regulating the length and conditions of maternity leave, the availability of public childcare for young children, and labour market flexibility allowing women to return to part-time work or to a position that facilitates combining work and motherhood (Cukrowska--Torzewska and Lovász, 2020).

Education is partly responsible for the gender gap in the labour market. The panels in Figure 4.2 compare activity, employment and unemployment rates for the years 1995–2020 by gender and educational attainment. According to the definitions used in the Labour Force Survey (LFS – Polish: Badanie Aktywności Ekonomicznej Ludności [BAEL])[2], the activity rate defines the percentage of economically active people (both employed and unemployed) of a given category (e.g., gender or education) in the total population of a given category (with the same characteristics). The employment rate is the percentage share of employed persons in a given category in the total population of that

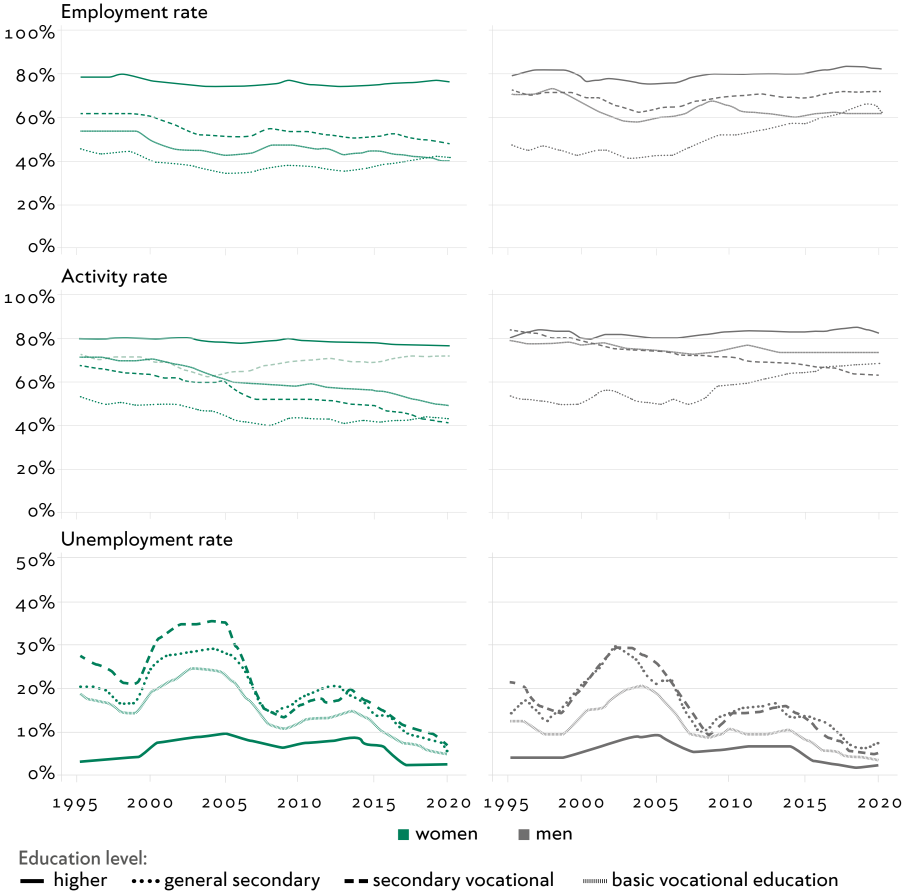
2 bit.ly/42pxHPt [accessed: 12.06.2023].

category, while the unemployment rate is the percentage share of unemployed persons in the number of economically active persons of a given category[3].

It can be seen that regardless of gender, having a tertiary education improves the labour market position. Both women and men in this group had better activity, employment and unemployment rates than those with a lower level of education. The activity rate of women with tertiary education remained at a similar level between 1995 and 2020 and was significantly higher than that of women with lower secondary education and basic vocational education. This gap increased steadily over the period, reaching its peak in 2020. For men, there was a slightly different pattern: tertiary education went hand in hand with a higher activity rate, but not to the same extent as for women. Until the early 21st century (there were years when the lines in the graph crossed in this category), a university degree was not associated with a significantly higher activity rate than for men with secondary vocational or basic vocational education. Men with general secondary education were the worst performers in this respect, only "catching up" with those with other levels of education towards the end of the period analysed. At the same time, tertiary graduates started to pull away from other groups in activity rate comparisons. In particular, the gap between them and those having completed basic vocational education widened. The activity rate of the latter systematically decreased and has been at its lowest level in recent years. Between 1995 and 2020, the activity rate of men with general secondary education also increased, while the labour force activity rate of women decreased.

3 Terms used in public statistics, bit.ly/3NXDmb3 [accessed: 12.06.2023].

FIGURE 4.2. SELECTED LABOUR MARKET INDICATORS BY GENDER 1995–2020



Source: Badanie Aktywności Ekonomicznej Ludności (BAEL) 1995–2020.

A similar pattern was observed for employment and unemployment rates. There was a larger employment gap between university graduates and women with lower levels of education. By the end of the 2010s, this gap had widened further. For men, the gap between education levels was not as significant and even decreased over the analysed period. There has been a clear increase in the employment rate of men with lower secondary education, which in the mid-1990s was much lower than for other education categories.

Between 1995 and 2020, the unemployment rate was higher for women than for men, regardless of the level of education, but the gender gap was the smallest for those with tertiary education. In 2020, it was 0.3% to the disadvantage of women (1.3% for those with secondary vocational education and the same for those with basic vocational education). It is important to note that up to 2022, regardless of gender, the unemployment rate decreased as the level of education increased.

As shown by the differences in labour market indicators for men and women, education may play a different role in the economic position of the two genders. In terms of activity rates, only women with tertiary education were on a par with men. However, even for those men who had completed their education at a lower level, this measure was still relatively high. The same was true for the employment rate. Women with tertiary education gained an advantage over those with lower levels of education. However, the same trend could not be observed for men. Compared with other education categories, having a tertiary degree also reduced the gap in the unemployment rate between women and men to a greater extent.

Urszula Sztanderska and Gabriela Grotkowska also highlighted the different effects of tertiary education for women and men on labour market opportunities. The researchers showed that since the early 1990s, only a university degree has protected women from unemployment to the same extent as was the case for men with an equivalent level of education. Women were at a greater risk of exclusion from the labour market if they had left the education before tertiary level. Female graduates of basic vocational schools were particularly disadvantaged. Compared to female graduates and men with an equivalent education, they were less active, more often unemployed, and had a lower employment rate (Sztanderska and Grotkowska, 2009).

Reports from other countries also suggest that higher education may better protect women from being marginalised in the labour market. In Finland, for example, female university graduates were unemployed for a shorter period of time and at a lower frequency than their male counterparts (Ollikainen, 2003). Women with a lower level of education were more likely to be unemployed compared to more educated members of their gender and compared to men, regardless of their level of education (Theodossiou and Zangelidis, 2009).

In general, higher education graduates have an advantage in the labour market over those who left education at an earlier stage. However, the benefits of having completed tertiary education – both in terms of earnings and increased employability or reduced risk of unemployment – differ by gender. It can be hypothesised that tertiary education reduces the risk of labour market failure to a greater extent for women than for men. Although men are subject to the same market mechanisms, in their case the link between the diploma they hold and their professional position is looser and is compensated for by other factors. It is therefore possible that one of the factors motivating women to stay longer in the education system is their weaker position in the labour market (lower wages, higher unemployment, lower participation). Due to their greater exposure to the effects of numerous exclusion mechanisms and occupational marginalisation, a tertiary degree is sometimes seen by them as a hedge against potential risks and uncertainties. In other words, women may invest more in education because it can help them overcome their unfavourable position in the labour market.

There are several possible reasons for this convergence of indicators of labour market position between women and men who have completed tertiary education. Firstly, female secondary and vocational school graduates are less successful in overcoming labour market difficulties than those with university degrees. Studies to date show that Polish women with a lower level of education are less economically active than other women in EU countries. However, such differences are not observed among female university graduates. Iga Magda (2020) explains the lower participation of less educated Polish women in the labour market by pointing to a number of cultural and structural factors. This may have been partly due to the burden of motherhood, which in Poland is more likely to lead to inactivity than in other EU countries. An inadequate network of nurseries and kindergardens, and a lack of confidence in this form of childcare exacerbate the situation. A survey conducted at the time of the reform lowering the compulsory school age showed that half of the respondents would prefer a 4-year-old child to stay at home rather than attend a kindergarten (this opinion was more common among people with lower levels of education), (CBOS, 2009a).

Another reason may be the greater willingness of women after graduation to discount the costs incurred for their education. The research indicates that people with tertiary education were less likely to be willing to give up work for financial compensation. When asked if they would be willing to stop working if their partner earned enough, an average of 52% of women and 38% of men said they would. The size of the gap differed significantly by gender and education. Women with low education were the most willing to stay at home, and this willingness decreased significantly among female university graduates (CBOS, 2013). Presumably, this is because, compared to university graduates, women with non-tertiary education do not receive sufficient economic and non-economic benefits from their work. This would confirm the relative advantage of women with tertiary education in the labour market over women with other levels of educational attainment.

4.3. Gender differences in the perception of economic situation

Surveys show that the willingness to pursue tertiary education was partially driven by a desire to have better economic prospects. Respondents were also driven by the fear of being unemployed, as was the case for young people making educational choices in the 1990s. For some young people, pursuing university education was a strategy for surviving a period of the most acute economic changes. Survey analyses show that women were more likely than men to express anxiety about their job prospects. This difference is only slightly affected by the economic situation. Surveys conducted by CBOS since the 1990s have consistently shown differences between adolescent girls and boys in how they see their future in the labour market. In the early years of transition, fear of unemployment was expressed by a total of 77% of secondary school leavers, but the differences between the two genders were marked. Female students were more likely to believe that they would not be able to find "any" job, while their male counterparts feared that they would not be able to get a "good" job (CBOS, 1991; 1992). In 1996, when the most rapid economic changes were taking place in Poland, the gender gap was still large: 24% of female students compared to 10% of male students in the final year of secondary education expressed great concern about not being able to find a job after graduation. Other proportions were found among those feeling positive about the future. 9% of girls and 21% of boys felt confident that they would be able to get a job (CBOS, 1996b). In the years that followed (CBOS, 2019b), there was a significant decrease in concern about the risk of unemployment, although it continued to be felt more strongly by women. In 2016, more than half of female students in their final year of upper secondary school still feared becoming unemployed. Only one in three male students felt the same way. An even bigger difference could be observed among those who were convinced that unemployment could definitely be avoided. In 2016, this was the case for one in three young men and only one in ten young women (CBOS, 2016). Similar gender differences were found among adults. In 2018, 25% of women and 16% of men expressed concern about the prospect of losing their job (CBOS, 2018c). Two years later, 24% of women and 16% of adult men reported difficulty finding work in the immediate area (CBOS, 2000).

Differences in women's and men's perceptions of their career futures seemed to be consistent. Women were cautious and anxious, while young men were optimistic and confident about avoiding failure. It is important to note that the concerns of women are justified, as they result from their disadvantaged position in the labour market, higher risk of unemployment, and lower chances of finding a job. Such messages about differences in employment opportunities between men and women reach young people from a variety of sources and may have an impact on the adoption of appropriate strategies regarding, among other things, the issue of investing in education. Work-related concerns can also have other effects. As Chris Dawson (2017) explains, women's greater anxiety and pessimism are directly related to their perceived inferior position, but also to their negative self-bias towards their own occupational position and employers' expectations. This tendency makes them more likely to undervalue their skills, lower their salary expectations, and overestimate risks in many areas of their personal lives. Men, on the other hand, are generally more likely to value their achievements and skills more positively and to underestimate risks (Beyer and Bowden, 1997).

Taking into account the results of the above studies and the economic indicators discussed herein, it is possible to hypothesise that women's decisions to study are driven by a desire to reduce (to an acceptable level) anxieties related to the labour market and related risks (e.g. unemployment). The economic value of a degree may vary, but in general, it increases the chances of entering a relatively stable career path. Given the various ways in which a market advantage can be built – such as networking, cleverness, ingenuity, hard work, and a little luck – education is a relatively safe investment that cannot be squandered. The tendency for women to make safer investments is also evident when young people decide on their future. In the 2016 and 2018 slightly more girls than boys reported that they would be willing to continue their education if they could not find a suitable job. It is also symptomatic that men are more likely to decide to start their own business in such a situation (CBOS, 2016). Any decision about the future involves a certain amount of risk and uncertainty, but in the context of different ways of achieving a good professional position, education seems to be relatively the safest path to secure a career.

When considering their career, a large proportion of young women take into account the skills expected by future employers, and a university degree is one such requirement. Table 4.2 shows the percentage distribution of 15-year-olds' responses to the question about their education and career plans. In the scenarios presented to the respondents, the largest gender difference appeared in the statements concerning entering higher education because of the need to meet the requirements of a future job. This answer was given by 40% of female students and 26% of male students. Young boys were more likely than girls to plan to take a job that did not require having higher qualifications and were more likely to say that in five years they would do something else than study or work.

TABLE 4.2. 15-YEAR OLD STUDENTS PLANS CONCERNING EMPLOYMENT AND EDUCATION, 2018

What do you think you will be doing 5 years from now?	Women	Men
I will be studying because the occupation I want requires a study degree (e.g., a diploma or university degree).	40.8%	26.9%
I will be studying because I do not know what I would like to do yet.	18.3%	15.9%
I will be working because I need to be financially independent.	14.5%	19.5%
I will be studying or working for other reasons.	11.5%	12.1%
I will be working because the occupation I want does not require a study degree (e.g., a diploma or university degree).	10.2%	16.9%
I will be doing something else.	4.7%	8.7%
total	100	100

Source: PISA 2018.

It is possibly this factor that contributes to the different educational and career plans of young women and young men. One of the hypotheses explaining the gender gap in education is that young women choose a safer, predictable career path that includes a degree. It is possible that similar considerations determine occupational and workplace preferences. In 2021, women accounted for 62% of those employed in the public sector, compared to 42% in the private sector (BAEL, 2021). More women than men with tertiary education were employed in this sector; 53% and 37%, respectively, in the second decade of the 21st century. Women with tertiary education were also prevailing in specific branches of the public sector such as administration, education, and health care. In 2021, 38% of those with a tertiary education diploma were employed in these areas, compared with 37% of women active in the labour market. As many as 22% of women were working in the education sector (BAEL, 2021). Fewer were employed in administration (12%). Adding another 14% of women employed in health, it appears that 48% of women with tertiary education found employment in these three sectors.

It is unlikely that workers are attracted to the public sector by the level of pay alone. Studies carried out in Poland show that, after accounting for differences in the structure of employees in a group of people with the same characteristics (gender, education), differences in pay exist between the public and private sectors (to the disadvantage of the former). The largest differences in pay were found among higher education graduates and among women. Women are more likely to work in the public sector, however, the salaries they receive there are lower than those they could expect in the private sector. As an explanation for this irregularity, Gabriela Grotkowska (2016) points to the non-wage benefits of working in the public sector, such as a sense of job security and stability, and a lower dependence of wages on economic cycles, which compensate for the lower salary. In the 2010 European Social Survey, stability was also considered a very important criterion when choosing a job by 65% of women and 50% of men with tertiary education. The difference was even greater in terms of the ability to reconcile work and family life: 49% of women considered this a very important factor, compared with 31% of men.

It can be hypothesised that the need to reduce labour market risks affects the decision of women with a university degree to work in the public sector and some of its more female-dominated branches, as in the case of education.

4.4. Summary

In this chapter I explained the education-related decisions of women and men from the point of view of their differing economic situations. The education--as-a-hedge hypothesis presented above suggests that women's more challenging labour market position may motivate them to invest in longer learning cycles than men. Seeking more secure career paths may, at least to some extent, be a response to the perceived insecurity of some women in the labour market. Young women – both those with and without work experience – are more likely than men to fear unemployment. The completion of higher education may reduce the risk to an acceptable level. Such regularity can be observed in the analysis of the basic indicators that describe the situation of the two genders in the labour market. Participation in the labour force and the employment rates of women and men are comparable only in the group of respondents holding a higher education degree. Women who left education at an earlier stage were worse off than men with a similar education.

It is not possible to explain all the education-related motivations of females by linking the issue of women's predominance in tertiary education with their situation in the labour market. It is clear that not every young woman is equally concerned about her future career, nor does every young woman's choice of employment in the public sector have to do with a desire to work in a relatively more stable environment. A great many of them, however, will have to deal with stereotypes and fixed beliefs of employers, which often rank them in absentia as less deserving of employment or promotion. In such situations, too, a tertiary education degree may prove useful. Irrespective of individual career ambitions, a significant proportion of women still feel disadvantaged because of their gender and many decide to counteract it.

5

Social and personal differences in relation to the gender gap in education

Education involves costs. The traditional (and somewhat outdated) view proposed by classical economics tends to focus mostly on financial outlays required to cover the direct costs of being educated. In societies that do not use discriminatory mechanisms, these costs are similar for all, so that the chances of educational attainment depend on non-economic educational resources (Becker et al., 2010) such as conscientiousness, hard work, ability to cooperate with others, and ambition. Succeeding in school is also easier if a student can internalise the school's rules and is guided by the values important to the institution.

Thanks to research into the impact of individuals' social skills and psychological characteristics on their educational and occupational success, we are getting closer to explaining the differences in schooling choices between men and women. Literature on the subject suggests that girls on average adapt better to the school ecosystem than boys with the same level of intelligence, which reduces their "cost" of schooling. This hypothesis has been advanced, inter alia, by Gary Becker (Becker et al., 2010), a Nobel Prize winner who argues that more advanced non-cognitive skills held by women allow them to perform better in school with less effort. Consequently, the net returns to education for an average woman are higher than for men. This is because they invest less effort in learning and have relatively high educational attainment (Becker et al., 2010). Empirical studies, at least in part (Terrier, 2020), support this hypothesis. They show that girls tend to excel in certain school-related social skills and have personal traits that are particularly useful in education. In this chapter I will examine gender differences in non-congnitive aspects related to school attainment using a variety of complementary sources of information.

Using surveys conducted among adolescents (e.g., PISA), I will compare male and female students' attitudes towards school, juxtapose girls' and boys' studying habits, and compare their aspirations for the future. Drawing on available research in the area of individual differences, I will also analyse some personality traits that are conducive to educational achievement. I have used selected official statistics to test the hypothesis that girls and boys use different methods to adapt to the school environment. Overall, studies suggest that girls have advantages over boys in certain cognitive skills, which involve personality, attitudes, and pro-social behaviour. It is probable that such factors make it easier for girls to do well in school. This positively influences their performance and encourages them to stay in education longer than boys.

5.1. Impact of non-cognitive factors on educational attainment

Intelligence occupies an important place among the factors that influence performance at school. It enables individuals to select information, creatively combine new and old knowledge, and flexibly use information in unfamiliar contexts (Kossowska and Schouwenburg, 2000). Among the different types of intelligence that influence school performance, an important role is attributed to crystallised intelligence, formed as a result of a person's interaction with the external world, i.e., in the process of learning and gaining experience. Crystallised intelligence is influenced by an individual's environment and cultural contexts. In contrast, academic achievement is less strongly associated with fluid intelligence, which is the ability to perceive relationships between abstract symbols, regardless of prior knowledge (Nęcka, 2003). However, the two types of intelligence are interrelated and are correlated with academic achievement (Strelau, 1987; Roth et al., 2015). Bettina Roth et al. (2015) have also highlighted the importance of verbal intelligence, which is linked to reading and writing skills as well as effective communication and a rich vocabulary. Presumably, better educational outcomes are achieved by students who can efficiently process the information they read, and who can formulate and communicate thoughts according to school standards. However, researchers have found that, regardless of intellectual development, students continue to perform very differently. It is not always the case that those with the highest levels of intelligence achieve the best results in examinations, and the best students are not necessarily above average in terms of intelligence (Turska, 2006).

Intelligence, understood as the ability to process information and synthesise knowledge in a creative manner, cannot be the sole source of educational achievement. Non-cognitive skills, which make it easier to participate in the social environment, were found to differentiate education performance as well. Evidence of the positive influence of factors other than intelligence had already been provided by the pioneers of social research, including Francis Galton and Charles Spearman (De Raad and Schouwenburg, 1996). At the end of the 19th century, the former recognised the positive influence of mental factors on academic achievement. The latter analysed the importance of students' self-control. In subsequent years, researchers explored the influence of other individual factors on school attainment, including curiosity, temperament, cognitive style, motivation, and the ability to respond appropriately to different situations.

The impact of personality on academic achievement has been systematised through the conceptualisation of the Big Five Personality Traits theory. Research using the Big Five theory shows that of the five factors – extraversion, neuroticism, openness, agreeableness, and conscientiousness (Strelau, 2005) – the last has been consistently and most strongly associated with academic achievement (Kossowska and Schouwenburg, 2000; Steinmayr and Spinath, 2009; Dumfart and Neubauer, 2016). This seems to be a fairly intuitive relationship. Conscientious people are hardworking and reliable, have a strong will, and are determined to pursue their goals. High levels of motivation, self-discipline, orderliness, dutifulness, and resilience in the face of failure help to achieve school goals. At the other end of the scale are students with low levels of conscientiousness, who tend to act spontaneously or impulsively and are likely to formulate short-term goals (McCrae and Costa, 1997; Strelau, 2005). These traits can make it difficult to carry out routine school activities. Such personality dimension can also reduce the motivation to learn.

Other traits also have a positive effect on academic performance, but not as consistent as conscientiousness. People with a strong sense of imagination, a curiosity about the world, and a willingness to question authority also tend to perform well at school. In contrast, the relationship between openness and academic indicators was generally weak or absent (O'Connor and Paunonen, 2007). Neuroticism has not been significantly reported; however, it is generally associated with a negative impact on educational attainment (Sobowale et al., 2018). Those with high levels of neurosis are particularly likely to experience problems at school, have limited ability to control their behaviour and tend to worry excessively, give up easily and become discouraged in challenging situations. A heightened sense of anxiety, fear of failure, and tension in situations perceived as dangerous can also be a manifestation of neuroticism. Among other things, these factors impede knowledge acquisition by contributing to a negative self-image and lower self-efficacy (Petrides et al., 2005).

The relationship between two other personality traits – agreeableness and extraversion – and academic achievement is even more difficult to establish. The ability to adapt to social situations, positive attitudes towards others, as well as sociability and excitability, have a positive, though small effect on educational performance (O'Connor and Paunonen, 2007; Poropat, 2009). However, this does not mean that these factors are completely neutral for students. On the one hand, certain aspects of extraversion (e.g., positive emotionality) can help students approach routine tasks with energy and enthusiasm, but on the other hand, the sociability and activity that reflect this trait may limit this need.

The lack of clear conclusions regarding the impact of traits such as extraversion, openness, and agreeableness on academic achievement may to some extent reflect how researchers have come to understand school performance. It tends to be defined quite narrowly, as the knowledge and skills acquired through learning. A broader view, taking into account aspects such as creativity in solving problems, an unconventional approach to tasks, and teamwork skills, may link it more strongly to openness to experience and extraversion, and assign a lesser role to conscientiousness (Wolfradt and Pretz, 2001). Another reason for the loose relationships between some aspects of personality and academic achievement may also be a more complex relationship between them. For example, Ewa Czerniawska (2008) demonstrated the role of mediating factors such as learning strategy and motivation. The first aspect refers to the two levels of knowledge acquisition – the superficial and deep level – which differ due to the degree of processing of the information. By combining existing knowledge with new knowledge and the ability to use these resources in different contexts, the deep learning style is associated with greater mental flexibility. Superficial processing, which only involves the reproduction of knowledge, does not provide this kind of flexibility. Research conducted among lower and upper secondary school students (Czerniawska, 2008) confirms that there is a link between openness to experience and the ability to adapt one's learning style to circumstances and deep processing of content. An effective learner is associated with such qualities as being methodical and disciplined. A model student is reliable, persistent, and has a high degree of self-control and resilience (Kossowska and Schouwenberg, 2000).

Yet, learning is just one aspect of schooling. One must not forget that learning occurs in a specific social context. School interactions require a certain level of social skills, including the ability to cooperate with others, identify social roles in a group, and recognise group hierarchies. At the same time, learning takes place within a narrowly defined set of rules that stigmatise anti-school behaviour and reward conformist attitudes. It is, therefore, not surprising that students who have developed pro-social skills and who can adapt more easily to the demands of school life tend to perform better. Studying regularly, avoiding conflicts with peers and teachers, showing empathy, and exercising self-control are all factors that directly translate into better grades (Caprara et al., 2008; Farrington et al., 2012; Lechner et al., 2017). Students who have a "social and personal GPS" are quicker to recognise the informal school rules and adapt to them more easily. Social skills also have the effect of fostering a sense of belonging to the school community. Equally important for the development of attitudes towards school is that these skills are perceived by students as positive rather than negative.

Research suggests that there are a number of personality traits that facilitate school performance and promote better educational outcomes. According to ingrained stereotypes, girls are more conformist about school standards, more diligent, more systematic, and less likely to cause behavioural problems. These popular beliefs, however, are only partially supported by research findings.

5.2. Personality, gender, and educational attainment

Research findings on the impact of psychological characteristics on school performance of male and female students are inconclusive. Some analyses claim that women are more conscientious than men, but the differences in this regard depend on cultural background (Weisberg et al., 2011; Vianello et al., 2013) or are limited to only some aspects of this trait. The study by Harald Freudenthaler et al. (2008) shows that intrinsic motivation is a predictor of academic achievement, yet its effect is less pronounced for females. Boys scored higher on measures of passion, which, like conscientiousness, is the driving force that makes people want to engage and act (Sigmundsson et al., 2021). In contrast, Angela Duckworth and her colleagues have shown that self-control has a greater impact on the achievement of female students and prevents them from dropping out of school (Duckworth and Seligman, 2006; Duckworth et al., 2015). However, there is no convincing evidence that neuroticism has a differential effect on the performance of male and female students. Research suggests that females score higher on this scale and lower on emotional stability aspects, both of which tend to negatively affect academic performance (Poropat, 2009). These two factors are expressed through deeper negative emotions, increased levels of anxiety, emotional volatility, and becoming angry more easily. They are also associated with a lower tolerance for stress and an increase in reactivity to potentially threatening situations. Although it does not have the same impact as conscientiousness, neuroticism can affect academic performance in other, more complex ways. It can manifest itself in a tendency to avoid situations the consequences of which are uncertain and which, on a subjective assessment, may evoke difficult emotions. One domain that often evokes unpleasant feelings is mathematics. This field is unique not only because of the domain it covers but also because the acquisition of mathematical knowledge can be easily disrupted by anxiety which leads to the tendency to abandon more difficult tasks in favour of easier ones (Choe et al., 2019). What is relevant here, is that mathematics is feared by people who have elevated level of anxiety.

The relationship between anxiety, which is based on personal predispositions, and the fear of mathematics often leads to the development of a lasting negative reaction towards this domain. The generally higher levels of neuroticism among women may also help to understand why they are more likely to experience negative emotions in relation to mathematics and to withdraw from this domain. This increases the tendency to succumb to stereotypes, which, as in the case of maths anxiety, precedes the onset of negative emotions (Shapiro and Williams, 2012).

Gender differences in education may also be affected by self-regulation. Mirjam Weis tested various dimensions of this factor, i.e., a mechanism for controlling emotional and behavioural responses, and showed that different levels of this trait in the two genders were the explanation for the differences in their verbal test scores. On average, women's higher levels of motivation and ability to pursue a goal despite distractions, their adherence to rules, and their ability to focus are particularly important in domains where communication skills are important (Weis et al., 2013). However, it is uncertain whether boys' and girls' educational choices are influenced differently by the ability to delay gratification. It refers to the capacity to from seeking immediate rewards or instantly meeting pressing needs, to put duty before pleasure, and to stick to decisions despite temptation or setbacks – can have a positive impact on their school performance. The ability to delay gratification is important in the context of everyday school life, especially when faced with a choice between learning and entertainment, or when educational failures undermine motivation and self--confidence. Some studies (although not many) suggest that women have greater self-control (Silverman, 2003; Dittrich and Leipold, 2014), which may help to explain their academic advantage.

Some of the studies on the impact of gender on educational attainment indicate that certain traits are intensified among women (e.g., perseverance and persistence as well as awareness of one's own skills), but this cannot be linked to conscientiousness. The variety of non-cognitive elements – of motivation, goal setting, passions, and educational aspirations – can make it difficult to find a simple answer to the question of how they translate into individual educational attainment of women and men. It is also worth noting that most of these factors have a positive effect on educational attainment regardless of gender. However, gender may alter the strength of the relationship to some extent. Furthermore, it should be noted that the strength of individual factors or their dimensions are distributed similarly for women and men. In practice, this means that some women, for example, may have lower levels of neuroticism than men. Nevertheless, on average, women score higher on this scale.

5.3. Attitudes of male and female students towards school

Certain aspects of personality may influence academic performance. However, there are many other types of characteristics and skills that are also important in this context. This section focuses on selected aspects of school performance and possible differences between male and female students. Here, I compare students' attitudes towards school, their approach to school duties, their motivation to learn, and their absenteeism. To do this, I have used the results of the international PISA survey. The survey is conducted among 15-year-olds, a group of particular interest because, at this age, students have already formed relatively stable preferences about education, learned ways of coping at school, and developed patterns of interaction with peers and teachers. At the same time, they are faced with an important decision concerning their next level of schooling. At the time of the survey, the young people in the sample analysed were in their final year of lower secondary education. Gender differences at this stage of education result from different experiences and attitudes formed earlier and may be a strong predictor of future decisions. The analyses carried out focus on selected available indicators of attitudes towards school.

5.3.1. Attitude to school and schoolwork

The research discussed above has shown that girls are better at internalising school rules, while boys are less enthusiastic about school, have a more critical view of it, and are more likely to challenge school rules and engage in anti--school behaviour (Van Houtte, 2004). Gender differences in this respect are important because, without a positive attitude towards school, it is difficult to develop intrinsic motivation to learn every day, to perform routine activities at the expense of indulging pleasures, and to believe that the knowledge and skills acquired will bear fruit in the future.

In the 2012 and 2018 PISA surveys, students were asked to respond to a series of statements expressing a "meritocratic" attitude to learning. They were asked about the importance of "working hard" at school and whether the effort they put into their studies would enable them to get a good job or go to university. In both rounds of the survey, a clear majority of the students expressed the belief that hard work would lead to positive results in the future. Perhaps this is related to the aforementioned opinion of young people that success on the labour market only partly depends on the degree obtained, and other than that on cleverness, resourcefulness or entrepreneurship.

TABLE 5.1. GIRLS' AND BOYS' ATTITUDES TOWARDS EFFORT AT SCHOOL (PISA 2012 AND 2018)*

I agree with the following sentence:	Year	Girls	Boys
Trying hard at school will help me get a good job.	2012	84.5%	77.2%
	2018	79.3%	70.7%
Trying hard at school will help me get into a good college.	2012	96.1%	89.6%
	2018	91.3%	86.7%
Trying hard at school is important.	2012	87.4%	76.6%
	2018	80.2%	69.9%

Source: PISA 2012; 2018.

* The table presents the percentage of “strongly agree” and “agree” answers.

In both rounds of PISA, boys were less convinced about the positive impact of hard work at school on their success later in life. This applies both to securing a good job and getting into university. There were relatively large differences in opinions about the prospects of being able to get a good job. This result further confirms the hypothesis presented in the previous chapter regarding education as an insurance policy (studying should help women to leverage labour market risks). Such a belief makes it easier to decide to go to university and to activate the cognitive, economic, and psychological resources needed to do it.

Girls and boys also differed in their responses to the statement: “Trying hard at school is important”. Interpreting the responses obtained in the light of other studies on conscientiousness, it can be concluded that girls tend to be less pragmatic in their approach to learning and less likely to need a specific reward to see the point of their school efforts. Perhaps boys have a more instrumental approach to learning and are, therefore, in need of some additional motivation or incentive (which could be, for example, the prospect of tangible benefits or the vision of a reward). This is an important distinction, as the desire to learn based on instrumental considerations may weaken if the incentive that stimulates it disappears. It is possible, therefore, that women's less pragmatic attitudes to education lead them to invest their resources even when they are not likely to get rewarded. This would also explain why their educational decisions are less sensitive to changes in the economic environment (e.g., rising or falling unemployment) and why their motivations are rooted in a more stable axionormative system.

Further analysis shows that gender differences in the valuation of education persisted when other variables were taken into account: test scores in mathematical reasoning and reading comprehension, SES, and stated intentions to go on to higher education (Annexe, Table A.3). There was a strong correspondence between the desire to go on to university and attitudes towards school, and once this was accounted for, the gender gap narrowed. They went hand in hand with a stronger belief in the value of education for both boys and girls.

Gender differences in attitudes towards school can also be observed in older PISA surveys (Table 5.2). In 2003 and 2012, respondents were asked to subjectively assess the effectiveness of their schools. They were asked, among other things, whether going to school was a waste of time and whether school provided the skills needed to choose a future career. These surveys have historical relevance, but worth noting is the marked increase in negative opinions between the 2003 and 2012 rounds. During this period, more male and female students expressed the belief that school does not adequately prepare them for adult life and that attending school is a waste of time. This was one of the highest spikes over the period compared to other PISA countries. Similar levels were only found in Slovakia, Thailand, and Tunisia.

TABLE 5.2. GIRLS AND BOYS ATTITUDES TOWARDS USEFULNESS OF SCHOOL (PISA 2003 AND 2012)*

I agree with the following sentence:	Year	Girls	Boys
School has done little to prepare me for adult life when I leave school.	2003	26.9%	38.7%
	2012	35.1%	41.6%
School has been a waste of time.	2003	6.1%	15.9%
	2012	13.3%	29.4%
School has helped give me confidence to make decisions.	2003	78.3%	74.6%
	2012	74.1%	68.3%
School has taught me things which could be useful in a job.	2003	82.1%	78.3%
	2012	73.6%	63.8%

Source: PISA 2003 i 2012.

* The table presents the percentage of “strongly agree” and “agree” answers.

A more complete, albeit ambivalent, picture of the respondents’ attitudes towards school emerges from the comparison of the answers to two questions presented in Tables 5.1 and 5.2. Students were convinced that their commitment to school would yield positive results in the future, but at the same time, they were critical of the school itself. On the one hand, this difference may be due to the growing belief of the generation born in the early 21st century in their own agency and intrinsic control, on the other hand, to the declining position of education in the hierarchy of factors influencing careers. The responses to the 2003 and 2012 questions (Table 5.2) paint a picture of the school as an institution that in the view of pragmatically-minded students does not adequately carry out its mission. Going to school may, therefore, be a waste of time for them, yet engaging in learning will give them a better start in adulthood. This may reflect the high degree of individualism within the generation, which believes in the importance of its own work but does not always recognise the potential of school institutions. It is not beyond the realms of possibility that the decline in university enrolment rates after 2010 has partly resulted from the fact that students (especially the least motivated) lost faith in the effectiveness of their schooling.

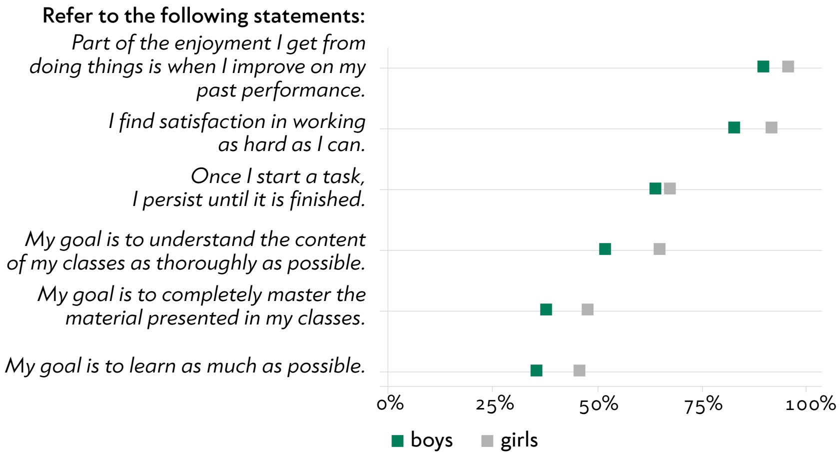
A notable difference could be observed in the responses of boys and girls to the statement "School has been a waste of time", which illustrates a particularly negative attitude towards education in this set of questions. Although the percentage of all students agreeing with the statement increased between 2003 and 2012, the rise was particularly pronounced among boys (by as much as one third). Subsequent PISA surveys (up to 2018) have not included this question, so it is not possible to verify whether the difference was permanent or episodic. However, these results are in line with other observations that point to less enthusiastic attitudes of boys towards school and their lower educational aspirations. For example, surveys conducted in 2003 showed that 60% of male and 58% of female secondary school students said they wanted to go on to higher education, but by 2018, these proportions had already changed significantly. They were 45% and 72% respectively (CBOS, 2019a). The differences in educational plans between men and women cannot be ignored, even if only some young people actually realise their intentions. Men's more negative attitudes towards higher education may contribute to their lower sense of belonging to the academic community and thus increase their risk of leaving university prematurely.

5.3.2. Motivations to learn

The level of intrinsic motivation, which is the driving force behind daily educational effort, is one of the factors influencing the differences between boys' and girls' attitudes to school responsibilities. In the 2018 PISA survey, motivation included two dimensions: focus on learning and consistent task performance. The former dimension relates more to educational goals and attitudes towards acquiring and extending knowledge, while the latter is linked with the level of commitment and persistence to persevere in the face of setbacks. These factors may play an important role in fostering positive attitudes towards education, as individuals who are committed and motivated perform better at school than those who do not have such characteristics, even after taking into account intelligence levels. Better results are achieved by students who are more persistent, who are more willing to engage, and who are able to maintain high levels of motivation throughout the duration of a task (Credé and Kuncel, 2008; Schwinger et al., 2009).

Figure 5.1 shows the percentage distribution of the answers given by male and female participants in PISA 2018 with regard to learning and motivation. It shows that female students were more likely to try to extend their knowledge, were satisfied with the effort put into learning and strived to understand the learning content. 15-year-old girls were more motivated to learn, more concerned with the ethos of learning, and more satisfied with their school performance. Overall, the responses indicate that girls on average have a higher acceptance of school requirements and standards than boys.

FIGURE 5.1. MOTIVATION TO MASTER TASKS BY GENDER (PISA 2018, N = 5192)*

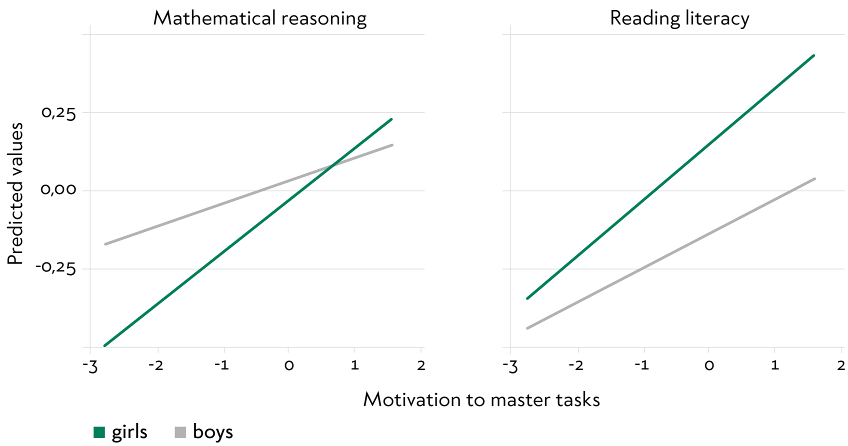


Source: *PISA 2018: Technical Report*.

* The figure presents the sum of percentages of "strongly agree" and "rather agree" answers.

Further analyses indicate that increasing focus on learning influenced test scores in reading comprehension and mathematical reasoning. However, this factor developed differently for male and female students. The panels in Figure 5.2 show the predicted test scores in these two aspects as a function of the level of focus on learning. In the case of mathematics, the correlation was stronger for female students and took a different course from that of male students. There was a particularly large difference when comparing the respondents with lower levels of motivation to learn. This may indicate that curiosity, the desire to broaden one's horizons, and the resulting satisfaction have a greater impact on women's mathematical performance than on men's. This means that girls need a stronger motivational stimulus to perform better in this area. Such a relationship is less evident in reading comprehension but is still stronger for women.

FIGURE 5.2. PREDICTED VALUES* OF THE MATHEMATICAL REASONING AND READING LITERACY TEST RESULTS DEPENDING ON MOTIVATION TO MASTER TASKS (PISA 2018, N = 5192)



Source: PISA 2018.

* The predicted values for test results in mathematical reasoning and reading comprehension were obtained using the linear regression model. Values along the horizontal axis present standardised values of focus on learning, and those along the vertical axis present predicted test results in reading and mathematics. The scale consists of statements transformed using the answers to the questions: "My goal is to understand the content of my classes as thoroughly as possible"; "My goal is to completely master the material presented in my classes"; "My goal is to learn as much as possible". The scaling method is described in the *PISA 2018: Technical Report*.

5.3.3. Learning after school

Adaptation to the rules and requirements of the school only partially reflect the overall attitudes towards the institution. Another indicator of students' commitment is the time spent studying outside the school. Homework forms an integral part of the school day for the majority of students. Some studies show a link between the habit of doing homework and the ability to self-regulate behaviour, which affects academic achievement (Ramdass and Zimmerman, 2011).

Given the data cited above, it should come as no surprise that female students on average spent more time doing homework than male students. In 2018, boys were almost twice as likely to report that they had not studied for even one hour after school on the day preceding the PISA survey, while girls were in the majority in the group that studied for more than three hours. Data from previous rounds of the survey, both in Poland and in other countries, confirms the existence of this difference. In 2012, for example, the average time spent on out-of-school learning was 7.8 hours per week for girls and 5.2 hours per week for boys. What might be the reasons for such a large difference?

Research suggests that girls' higher educational aspirations and attitudes towards school, as described above, may play a role. One possible reason for this could be an individual's growth mindset; some people tend to believe that intelligence can be developed through systematic study, while others believe that people are born with a certain level of ability and intelligence that can only be shaped to a limited extent by the environment. There is research to suggest that adopting a particular perspective on this is linked to educational attainment and that the belief that intellect can be further developed has a positive impact on academic achievement (Yeager et al., 2019).

Among the factors closely related to homework, it is also worth considering forms of out-of-school activities. There is no precise recording of such activities in the PISA 2018 data, but it is clear that for the younger generations, spending time online has been "competing" against learning . Female and male students do not differ much in their digital and online habits. In 2018, 45% of boys and 41% of girls reported that an online presence took up four hours of their average day, which means that, taking into account school attendance and time for basic biological needs, this activity consumes the largest part of their free time. However, the forms of online activity differed between the two genders. Boys were clearly more likely to use computer games on a daily basis – 19.4% of them (and 5.3% of girls) played single-player games and collaborative games were played by 32.5% and 4.6%, respectively. The latter variable was included in the model.

Analyses of the 2018 sample of Polish 15-year-olds (Annexe, Table A.4) show that girls spend much more time on homework. After controlling reading and mathematics scores, social status, and aspirations to go to university, the gender difference has remained. At the same time, it can be seen that after-school learning is correlated with aspirational variables: the desire to go on to higher education and a positive attitude towards school. Learning at home is negatively affected by video games, which is the only factor in this comparison that takes up students' attention and time (the effect on players was equally negative, regardless of gender).

It should be noted that the question about homework time was open-ended. It cannot be ruled out that the answers given by the students were, at least to some extent, tailored to the societal perceptions of their behaviour at school and that the declared commitment differed from the actual effort (Krumpal, 2013). However, it is difficult to determine the extent of any bias. It is also possible that girls overestimated the amount of time they spent working at home because of the existing stereotype of the "good student" and the associated social expectations of their behaviour at school. Even assuming that such biases influenced the responses of Polish adolescents, gender differences are relatively consistent across a variety of cultural and economic contexts and different school systems (*PISA 2015: Results in Focus*).

Time spent on homework is a problematic indicator of school engagement, but the data in this area is consistent with previous findings on gender differences. In addition to divergent normative patterns, female students are more committed to their education. In a relatively rigid school micro-system, this dedication is likely to pay off in two ways; on the one hand, extra study after school hours contributes to the consolidation of material and better test results, and on the other hand, it is a self-affirmation of the social image of one's own commitment that can encourage further educational achievements.

5.3.4. Student tardiness and truancy

The most common forms of school avoidance are tardiness, truancy, and absenteeism. The social origins of these behaviours may vary but what they have in common is that they have a negative impact on academic performance. In addition to the fact that absenteeism interferes with learning, it is often associated with other negative factors such as dropping out of school, unemployment, risky health behaviours and criminal activity (Maynard et al., 2015). In addition to social status, family structure and the level of parental involvement in the child's education, gender appears to be one of the factors that increase the likelihood of absenteeism (*PISA 2018 Results [Volume III]: What school life means for students' lives*).

The difference between male and female students is evident in both shorter and longer absences. In 2012, 47% of 15-year-old boys compared to 37% of 15-year-old girls were late for class at least once in the two weeks prior to the PISA survey. In 2015 and 2018, boys continued to predominate, also in the category of frequent lateness. In 2018, they were significantly more likely to be among the students who were late more than four times (30% of boys and 19% of girls) and five times or more (18% and 10%, respectively) in the two weeks prior to the survey.

A bigger problem than being late for a class is skipping a class altogether. Being absent from school completely excludes the students from the learning process, and the accumulated gaps in knowledge are difficult for the students to fill on their own. Similar to lateness, full-day absenteeism and skipping individual lessons were more common among boys. In 2018, 28% of boys and 21% of girls admitted to missing one or two full school days in the two weeks prior to the PISA survey, but the gap widened with the number of absences, with 10.5% of boys and 5.2% of girls missing three or more days of school.

The gender difference in absenteeism is shown in Table 5.3, which uses data from PISA 2018. There were more girls among the students who had not been late, missed a lesson, or missed a whole day in the two weeks prior to the survey. Among students with one or two absences (of any type), there was very little gender difference, and the more frequent the situation, the greater the predominance of boys.

TABLE 5.3. ABSENTEEISM AND ITS INFLUENCE ON TEST TEST RESULTS IN MATHEMATICS AND READING (N = 5625)

	Absences			Test results*	
	Boys	**Girls**	**Total**	**Mathematical reasoning**	**Reading literacy**
Students who neither arrived late nor skipped a class or a whole school day	43.6%	56.4%	100	-	-
Students who were absent once or twice	50.1%	49.9%	100	96.2%	95.5%
Students who were absent three or four times	55.9%	44.1%	100	94.3%	92.8%
Students who were absent more than four times	64.8%	35.2%	100	92.3%	90.3%

Source: PISA 2018.

* Percentage of points gained on tests by students who were absent from class in comparison to students who were neither absent nor late in the last full two weeks of school preceding the survey.

There was an almost linear relationship between absenteeism and lower test scores in reading and mathematics. Students who attended school regularly performed better than those who were absent sporadically. The more frequent the absences, the lower the average scores. In mathematical reasoning tests, students who had one or two absences scored on average 96% of the score of the students who attended school regularly, with successive absences widening the gap. The causal relationship between these factors is difficult to establish. It is unclear whether absenteeism influenced the decline in skills or whether absenteeism itself was the result of poor school performance. It is not difficult to imagine that students who persistently underachieve have little motivation to learn and find it beyond their ability to complete even basic school tasks.

The effect of absenteeism on scores in reading comprehension and mathematical reasoning (Table 5.4) varied by gender. Among those who had missed at least one day in the 14 days prior to the survey, the difference between females and males in mathematics tests scores was not statistically significant when controlling for SES. However in reading, boys scored lower than girls. A similar pattern was observed for students skipping classes. Boys scored lower than girls in reading comprehension tests, but the differences in mathematical reasoning scores were not statistically significant. Episodic tardiness had a negative impact on academic performance only for boys. Overall, the results of the survey suggest that boys who are late or absent from school scored lower than girls, especially in language skills (which they have on average at a lower level). It should be added, however, that absenteeism has a negative impact on both male and female students. Truancy, even episodic, was significantly lower among young people who planned to go to university than among those who did not. This was the case for both boys and girls.

TABLE 5.4. TEST RESULTS IN MATHEMATICS AND READING* OF STUDENTS WHO WERE SKIPPING CLASSES AND WERE COMING LATE TO SCHOOL (N = 5165)

	Girls	Boys
Came late to classes		
Mathematical reasoning test	-0.04	-0.06
Reading literacy test**	0.13	-0.21
Skipped a whole school day		
Mathematical reasoning test	-0.27	-0.26
Reading literacy test**	-0.06	-0.44
Skipped classes		
Mathematical reasoning test	-0.17	-0.14
Reading literacy test	0.00	-0.33

Source: PISA 2018.

* Predicted test scores for girls and boys obtained from a linear regression model when controlling for student social status (HISEI). Test scores were standardised with 0 [zero] mean and standard deviation of 1; Episodes of being late or absent occurred at least once in the two weeks prior to the survey.

** Gender differences are significant at $p < 0.05$.

5.4. Repeating a year

Truancy, poor academic performance, negative attitudes towards school, and externalisation of problems are behavioural categories that contribute to students dropping out of the education system prematurely. Repeating a year is a harbinger of this. According to data from Statistics Poland, the problem of repeat students is marginal in Poland. In the 2018/2019 school year, it affected 0.7% of primary school students and 1.05% of lower secondary school students. Of these, the majority were boys and this pattern was observed at both lower levels of education. However, Table 5.5 which presents the percentage of boys among all students repeating primary and lower secondary school, shows that this percentage has been decreasing, while the proportion of girls has been increasing: from 23% in 2005/2006 to 34% in 2018/2019 at the primary school level.

TABLE 5.5. PERCENTAGE OF BOYS AMONG STUDENTS REPEATING A YEAR IN PRIMARY AND LOWER SECONDARY EDUCATION IN THE YEARS 2006–2019

School year	Primary school	Lower secondary school (*gimnazjum*)**
2005/2006	77%	77%
2010/2011	72%	72%
2015/2016*	62%	69%
2017/2018	67%	70%
2018/2019	66%	60%

Source: GUS (Statistics Poland).

* In the 2015/2016 school year, the number of children repeating a grade increased by about 1,000 compared to other years included in the analysis. This may be related to the inclusion of children born in the first half of 2008 in compulsory education in 2014/2015. In 2014/2015, 6-year-olds accounted for 45% and the following year 73% of all children of this age in the first grades.

** Between 1999 and 2019, primary school lasted 6 years and was followed by a 3-year lower secondary school (*gimnazjum*). *Gimnazjum* educated students from the age of 13 to 16. Education at this tier of schooling was mandatory.

Table 5.6 shows the percentage of repeaters in the total number of students in each grade of primary education from 2016 to 2019. In 2018, 0.55% of female students and 0.96% of male students studying at this level. In grade two, the gender gap narrowed, but in grade three – the final stage of early childhood education – it increased significantly for both genders to 1.21% for girls and 1.53% for boys. In subsequent grades, the percentage was consistently higher for boys, reaching a maximum of 2.12% in grade seven (it was also highest for female pupils at this level – 0.96%).

TABLE 5.6. PERCENTAGE OF STUDENTS REPEATING A YEAR BY GENDER IN EACH PRIMARY SCHOOL GRADE AND PERCENTAGE DISTRIBUTION OF STUDENTS REPEATING A YEAR IN THE SCHOOL YEARS 2016/2017, 2017/2018, AND 2018/2019*

Year		I	II	III	IV	V	VI	VII	VIII
2016/2017	Girls	4.1%	0.66%	0.47%	0.51%	0.53%	0.34%	-	-
	Boys	4.9%	0.88%	0.64%	0.87%	1.03%	0.56%	-	-
Total		40.6%	16.9%	12.3%	10.9%	11.8%	7.3%	-	-
2017/2018	Girls	0.74%	0.9%	0.4%	0.23%	0.35%	0.26%	0.58%	-
	Boys	1.27%	1.15%	0.61%	0.48%	0.8%	0.66%	1.36%	-
Total		20.5%	12.1%	14.6%	10.4%	11.9%	9.2%	21%	-
2018/2019	Girls	0.55%	0.3%	1.21%	0.31%	0.3%	0.33%	0.96%	0.42%
	Boys	0.96%	0.47%	1.53%	0.66%	0.61%	0.68%	2.12%	0.88%
Total		13.4%	6.5%	13.2%	11.5%	10.7%	8.5%	25%	11.3%

Source: GUS, 2017; 2018b; 2019.

* The percentages in the table represent the quotient of the number of students in a grade by gender and the number of students repeating that grade as well as the percentage distribution of students repeating a grade in a given school year. Students who completed grade six in 2016/2017 and entered grade seven in the following school year.

The social reasons for repeating a grade in early education are different from those in the higher grades. At an early stage it is likely to be related to psychological and social factors that affect school readiness. Educational research shows that repeating a year is not the result of a single failure, but rather the accumulation of many factors that put the pupil on an unfavourable trajectory from the start of formal education. The unfavorable conditions may be initially invisible to both the teacher and the pupil, but over time they aggregate, which may lead to failure, the emergence of a negative attitude towards the school environment, and a lower sense of belonging to the school (Kupisiewicz, 1974). For this reason, younger pupils who enter the education system with different resources and competencies are the focus of attention in educational research. School readiness includes the ability to interact with the environment, express emotions appropriately, and limit impulsive behaviour. It also includes the ability to focus attention despite distractions and the drive to persist in completing tasks, even if this means sacrificing leisure activities (Brzezinska et al., 2012). Studies conducted on younger students show that girls outperform boys on many dimensions of educational readiness (Kopik, 2007). A study by Thomas A. DiPrete and Jennifer L. Jennings (2012) shows that gender differences in social skills and education-related behaviours (such as persistence, willingness to learn, and levels of self-control) can be identified as early as preschool but develop less strongly for boys in later years of schooling. In contrast, a study of Polish 6-year-olds found that boys were less disciplined than girls. They were more easily distracted and more likely to procrastinate. In terms of social relationships, they had more difficulty establishing harmonious relationships with others and were less able to control their emotions. Boys were more likely to receive help from teachers in organising their work. They also showed greater general fitness and physical activity. This was directly related to their lower motivation to complete teacher-directed tasks and had a negative impact on their persistence (Kopik, 2007). It is also worth noting that there were no differences in mathematical competence between 5- and 6-year-old boys and girls, but girls already at this stage performed better in writing and reading (Kopik, 2007; Oszwa and Gajownik, 2015).

Boys may enter education with some social and non-cognitive skills that are on average less developed than those of girls. However, at least some of these weaknesses are compensated for in the course of their education through conscious or unconscious training in the social environment. Repeating a year is a likely scenario if this training takes place in unfavourable social conditions. The 2018 PISA study found that students who repeated a grade had a significantly lower social status than their peers and performed less well in reading comprehension and mathematics tests. Social background is a major determinant of a student's educational attainment. Classical theories of educational inequality attribute the greatest impact on school performance to social and cultural capital (Bourdieu and Passeron, 2012), the most synthetic indicators of which are parents' occupation and education. This capital refers to a variety of tangible and intangible resources – such as aspirations, lifestyle, and social participation – the presence of which positively influences children's educational achievement. A lack of environmental support in the early stages following the onset of school difficulties is more likely to lead to the accumulation of deficits and the perpetuation of negative attitudes towards school. Moreover, comparative studies show that although the rates of students repeating a grade vary across education systems, it is consistently gender (female) and higher social status that protect them against this negative experience (Agasisti and Cordeo, 2017).

In higher grades, boys continued to be at greater risk of repeating a year, but problems with social functioning at school were compounded by deficits in knowledge and skills developed at earlier stages. A particularly large increase in the number of boys (but also girls) repeating a year was observed in grade seven in the 2017/2018 and 2018/2019 school years. At the time, the Polish education system was undergoing changes as part of the 2016 education reform. Among other things, lower secondary schools were abolished and – as a result of this measure – primary education was extended to eight grades.

As of the 2017/2018 school year, there were no admissions to lower secondary schools. After the transformation of the education system, the pupils of the sixth grade of primary school, who would have moved on to lower secondary school before the reform, continued their education in the seventh grade of the primary school. The 2018/2019 school year was the second since the education reform was introduced, but also the first after many years of having an eight-year primary cycle. Public controversy and protests by teachers, students, and parents arose over the situation of students in the new grades seven and eight, most of whom were 13 and 14 years old. A study commissioned by the Children's Ombudsman [Rzecznik Praw Dziecka] showed that almost 50% of teachers considered the contents of the 2017/2018 curriculum for grade seven to be too extensive. More than 90% of parents said that their children spent more time studying than in previous years. Teachers complained that they managed to cover just over half of the material in the core curriculum in class and had to leave the acquisition of the remaining knowledge to the students working on their own (Rzecznik Praw Dziecka, 2018). The official data on the number of primary school students repeating grades is too vague to draw broad conclusions about possible links between the shift in the organisation of the education cycle and the educational achievements of students who have undergone this change. However, it is possible that the greater accumulation of grade seven repeat cases in 2018 is at least partially the effect of the reform and the changes that came with it. Some studies suggest that the reorganisation of the teaching process may have had a negative impact on results, e.g., students who had their subject teacher replaced performed worse in secondary school final examinations in that subject than those who did not experience such a change (Szmigiel, 2006). It is also possible that the reorganisation of the schooling system could have affected weaker students who were already in the risk group.

5.5. Why do boys fall behind in education?

In 1992, 30% of males and 25% of females said they would go to university after leaving secondary school. In the following years, these proportions changed, and by 2018, half of male students and as many as 73% of female students said they would go to university (CBOS, 2019a). The information presented in the previous chapters helps to shed more light on these differences. The level of a student's social, emotional, and non-cognitive competencies (regardless of gender) at the time of entry into the education system affects their subsequent educational attainment (Ricciardi et al., 2021). On average, females score higher in social interactions, communication, cooperation with others, and concentration, i.e., those that indirectly affect school functioning. Some researchers have suggested that a higher incidence of neurodevelopmental disorders such as dyslexia, attention deficit disorder, and autism may explain boys' difficulties in adjusting to the educational institution environment. While research in this area suggests that gender may have an impact on the incidence and manifestation of different disorders, its impact on school performance is far from clear (Bölte et al., 2023). The same disorder may manifest differently in individual behaviour by gender and in individuals with specific deficits. One example is language skills; although these are lower on average in people with autism, there is considerable variation within this population. These symptoms manifest themselves differently in men and women, and as some studies suggest that, due to the different ways in which they are expressed, some disorders are diagnosed less often in women. This situation, particularly as regards the social and communication skills valued at school, may contribute to the differing difficulties experienced by girls and boys in adapting to the demands of school. In ADHD, one of the most commonly diagnosed neurodevelopmental disorders, the differences mainly relate to hyperactivity (Arnett et al., 2015) and rapid shifts of attention between tasks. The two genders do not differ in the frequency of most other symptoms, such as distractibility and impulsivity. It is also worth noting that students with neurodevelopmental deficits sometimes face non-acceptance, exclusion, and rejection from their peers. This further hampers their performance at school.

Functioning of boys in the education system may also be aggravated by a combination of specific social factors. An important part of this is the relationship with the immediate environment. Research suggests that unstable family relationships are more likely to reduce their academic achievement and increase negative responses such as aggression and externalising behaviour. Boys who are raised by single mothers are particularly vulnerable to the negative effects of family breakdown (Mencarini, et al., 2019; Autor et al., 2020). The mechanism behind this phenomenon is not well understood, but it is thought that a woman who raises a son on her own has less interaction with her child, pays less attention to him, and does not have as warm a relationship with him as she does with a daughter (Knopp, 2007). In such families, where resources for care and attention are limited, stereotypical beliefs about the emotional needs and inner lives of boys and girls may more strongly shape parent-child relationships. It is generally assumed that sons have fewer emotional needs than daughters and that expressing gender-non-conforming feelings is sometimes socially unacceptable. It can be assumed that boys in single-parent families take on, to some extent, the role of the adult male and, therefore, have to grow up more quickly than their peers who are raised by both parents (Scaramella et al., 2008). The lack of male role models is not the only cause of difficulties for boys from single-parent families. Failure at school is the result of "diluting" the parental resources of attention, commitment, and capital needed to invest in schooling. Meanwhile, research on how birth order affects academic achievement suggests that boys born as second children in families with two or more children are more likely to experience academic problems. The risk is lower for first-born sons, who are more likely than younger siblings to have psychological traits that correlate with career success, such as emotional stability, responsibility, and leadership (Breining et al., 2020). The reduced financial and psychological investment in each subsequent offspring partly explains the difference between first and subsequent children raised in the same family.

Disrupted family ties do not have a neutral effect on girls' educational outcomes either. However, girls may express the lack of stable ties in other ways. Research by Shelly J. Lundberg (2017) showed that girls from single-parent families were more likely to experience depressive episodes, also as adults, while boys were more likely to experience problems at school due to aggressive behaviour or neglecting educational responsibilities.

The influence of students' family background on their educational performance becomes even more important in the context of demographic changes in family structure in Poland. These include a shift away from traditional marriage towards less formalised relationships. Compared to the 2011 census data, the number of informal unions with children increased significantly over the next decade. Although still a small proportion compared to other family types (5.4% in 2021), this represents an increase of 68% over 10 years (*Preliminary results of the 2021 census*). Changing family relationships are also reflected in the systematic increase in divorces. There were 130 divorces per 1,000 new marriages in 1980, 268 in 2010, and 352 in 2020 (GUS, 2021d). The percentage of single-parent families also remains high. According to census data, single mothers with children represented 18.7% of all families in 2021, and fathers with children, 3.7% (an increase of just over 1 p.p. from the 2011 census). For the younger generation – both girls and boys – the changes in students' family environments create new conditions for emotional development and the formation of social skills. Previous research has confirmed that instability in family ties has a negative impact on children's social and emotional relationships, psychological well-being, health, and school performance (Gähler and Palmtag, 2015). The consequences of changes in family ties will increasingly be faced by students and schools.

5.6. Summary

School is a proving ground for social interaction. People who succeed at maintaining good social relationships, and who show greater social skills, conscientiousness, discipline, and commitment, are likely to perform at a higher level. A comparison between the two genders shows that there are differences in some areas with an impact on educational success. Firstly, boys are over-represented among students who exhibit behaviours that are negatively correlated with academic performance, such as truancy, repeating a grade, and skipping classes (the more serious the behaviour, the higher the gender ratio). Secondly, they are more likely to challenge, question, or be sceptical about school values. They are less committed to their educational responsibilities. This is especially the case when these tasks are limited to "just" acquiring knowledge. On average, they are less diligent and less ambitious. As they break classroom rules more often, boys are more likely than girls to be labelled as "problem students". Some of these differences are already visible in very young individuals, while others emerge as they progress through school.

But these differences do not mean that there are two separate worlds at school, with rebellious boys and polite girls. There are girls who will not accept school rules and who will ignore their responsibilities, while there are boys who are intrinsically motivated to learn, who are driven by ambition, and who never come to class after the bell rings or without homework. However, it is impossible to ignore the impact of average gender differences on the educational choices of women and men in many dimensions of school performance. In general, girls are better able to adapt to the reality of school life, while the majority of boys find it difficult to do so. This is one of the reasons why female students are much more likely than their male counterparts to take a university degree into account when planning their future. In this sense, one can agree that the non-cognitive "costs" incurred by girls at certain stages of schooling may be lower (Becker et al., 2010). It cannot be ruled out that factors such as conscientiousness, commitment, and are responsible for the gender gap in aspirations and for women outnumbering men in higher education. In parallel, education affects the labour market position of women and men differently (as discussed in the previous chapter). A low level of education is more likely to exclude women from economic activity than men, and it is only through tertiary education that these differences can be bridged. Therefore, it can be speculated that these two factors – better average adjustment of girls to the education system and the greater dependence of their careers on educational attainment than men – might have contributed to the widening of the gender gap in educational choices in recent years.

6

Gender disparity in school achievement

Traditionally, the main outcomes of the educational process are higher levels of students' knowledge and skills. There are several reasons why it is important to look at the school performance with a focus on gender disparities. First of all, grades obtained at school are predictors of students' later educational achievements. In Poland, higher semester and yearly grades are associated with better results in the secondary school leaving examinations (*matura*), (Skórska et al., 2014). Therefore, higher skills should pave the way to more ambitious educational goals. Secondly, test scores and grades provide the most reliable and easily accessible information about a student's knowledge, thanks to which, their social environment learns about their talents, interests, and characteristics (e.g., diligence) or lack of regularity in learning. It is widely believed that school grades trigger an avalanche of social expectations and presuppositions among parents, teachers, and peers concerning the intellectual and personal attributes of students. Moreover, for students, grades are an important indicator of their own strengths and weaknesses. They form their sense of efficacy and the competencies needed to make educational decisions. Finally, while social and emotional skills are linked to educational achievements, grades and test scores are a formal pass to the next level of education. Indeed, university candidates are asked about their examination results.

As demonstrated in the previous chapter, girls have an advantage in certain social skills, so it is worth asking whether this advantage persists in other areas. In this chapter, I will analyse boys' and girls' test results in two areas of knowledge that accompany them throughout their education and belong to the canon of intellectual competences. These are, first of all, mathematics or mathematical reasoning and, secondly, the Polish language and reading comprehension.

Comparing the achievements of boys and girls is also important for another reason. I have already drawn attention to the relatively persistent preference of women for social sciences and the humanities as well as their underrepresentation in mathematics-oriented paths. The admittance of university students in such majors is largely based on high mathematical competencies. To some extent, these competencies determine the chances of completing this stage of education. Insufficient skills, even with a lot of ambiton, make it impossible to obtain an engineering degree. On the other hand, high competencies in understanding and creating written texts open the door to studies in many fields of social sciences and the humanities, whilst reducing the chances of studying subject areas that involve a substantial portion of mathematics.

In this chapter, I will use data from two sources. The first comprises international comparative studies which have been conducted regularly for many years on random populations of students, based on a standardised methodology. In recent years, the PISA, TIMSS, and PIRLS studies have provided the education sector, the general public, and educational researchers with a great deal of information allowing an understanding of issues related to education in an international context, including gender disparities in the school domain. The second source is the results of Polish external final lower and upper secondary school examinations.

The two sources are not equivalent. In both cases, students solve sets of test problems, but in many respects, the basic concept, methodology and, therefore, the results are not comparable. Due to their international scope, studies such as PISA (covering 15-year-old students) as well as TIMSS and PIRLS (covering younger groups), are not rooted in the school curriculum of a particular country. They do not verify the extent to which students have mastered the core curriculum. Instead, they focus on measuring the skills needed to live in the modern world. Another important issue in the comparison of the source data is that participants of the international competence tests represent only a random sample of students from selected schools. National examinations, on the other hand, cover almost all students at a given level of education. It is also worth mentioning the difference in the rank which students attach to the two types of skill measurement. The results of the lower secondary and upper secondary school leaving examinations impact the choice of school at higher levels of education. They are also part of the evaluation of teachers and schools, who are eager to boast their results in various rankings. It is likely that this awareness motivates students to a greater extent than taking part in voluntary surveys. Despite these differences, the analyses of the PISA results and those of lower secondary school finals suggest a high correlation within specific subject areas, especially in the humanities (Szaleniec et al., 2012).

6.1. Gender differences in performance of third- and fourth-graders

One prominent issue in the debate on the skills of boys and girls is to identify the moment when the differences between them appear. Considering the selection and self-selection processes, one can expect that they will occur at later stages of learning. After completing early school education, curricula begin to diversify and offer students the opportunity to acquire knowledge in various fields of social sciences, the humanities, science, and mathematics. Throughout their education, students are free to take advantage of this offer according to their preferences, skills, and interests. Presumably, they will specialise in those areas of knowledge which they perceive as the most advantageous choice. In the Polish system of education, these preferences are sealed at the stage of secondary education, when students select learning tracks and specialisations, in addition to advanced--level subjects for the final secondary school exams.

The existence of differences in school performance is not so obvious among younger boys and girls. One can assume that in general, children at the beginning of education do not have any specific preferences regarding their favourite subjects, areas of knowledge, and teachers. They enter the school system with a clean slate, and any possible idiosyncrasies develop as they accumulate personal experience by interacting with the environment and the subjects being taught. Available research does not offer a lot to verify this scenario. Some findings reveal differences in the average level of mastering skills between Polish girls and boys already at the initial stage of education. In 2011, the TIMSS study noted the advantage of boys in mathematics in grade three (Konarzewski, 2012). However, this pattern was not confirmed by other studies conducted in this age group. Boys and girls who participated in the National Test of Third Graders' Skills (Polish: Ogólnopolskie Badanie Umiejętności Trzecioklasistów [OBUT]) between 2013 and 2015 (Karpiński et al., 2014) did not differ significantly as far as their mathematical skills were concerned.

Caution should also be exercised in drawing unequivocal conclusions regarding the mathematical skills of fourth-graders because the results of the TIMSS study in this group in 2015 and 2019 were inconsistent. In 2015, girls and boys achieved almost the same results in mathematical reasoning, so there were no statistically significant differences between them, also when divided into subdomains of mathematical skills. No differences were observed either in operations on numbers, geometry, and data representation, or in cognitive domains, including knowledge, application of mathematics, and reasoning (Konarzewski and Bulkowski, 2016). The results of the subsequent round of the TIMSS study in 2019 led to different conclusions. Boys performed better than girls on average, but the recorded difference was still relatively small. However, gender disparities were evident in specific areas of knowledge. Boys had an advantage in tasks involving operations of numbers featuring elements of estimation, while girls were better at tasks in which information had to be read, found, or deduced (Sitek, 2020).

The findings of the TIMSS study, which applies verified and relatively standardised testing instruments to students at the same stage of education, indicate that boys and girls in Poland have similar mathematical skills. The results of students from other countries participating in the programme also lead to similar conclusions. The particular rounds of the study suggest that the results of boys and girls in the fourth year of education either slightly diverge (not always in favour of boys) or do not differ at all. In the 2015 and 2019 studies, boys' averaged scores were higher in most of the participating countries, although this advantage was relatively small.

As far as the method of reporting student achievement is concerned, it should be pointed out that in the past, access to large samples of students was limited. It was, therefore, usually limited to publishing average results for both boys and girls. This method was convenient due to its simple calculation formula and ease of interpretation. However, the conclusions drawn on the basis of such data could be misleading, since the overall average compressed the score distribution into a single piece of information, saying little about the differences in individual parts of the distribution. Still, such information may be important for analysing educational decisions because some educational pathways require students to have above-average (not close to average) skills in a given field; higher, for example, in those who decide to study engineering than in those whose choice is pedagogy.

Subsequently, some researchers focus their attention on the proportion of girls and boys among the highest-scoring students more than on the averaged scores, which makes it possible to reveal some relatively persistent patterns. In the case of mathematics, analyses often show an over-representation of men on the left and right side of the performance distribution, that is, among students with particularly high or very low levels of skills. The predominance of boys in the top-scoring group has been observed both in recent international studies and in older analyses (Penner, 2008; Reilly et al., 2015; Keller et al., 2021). Such a pattern was noted in one of the first massive quantitative studies conducted by Camilla P. Benbow and Julian C. Stanley (Lubinski et al., 2001). Analysing SAT scores (one of the standardised aptitude tests for college admissions in the United States), the researchers demonstrated that in the first half of the 1980s, the gender ratio among the 0.01% of students with the highest scores was 13.5:1 to the advantage of men, after equating samples by age, gender count, and abilities. The researchers also noted that as the cut-off points of the score distribution increased, the gender ratio decreased and levelled out among the approximately top 5%. Similar conclusions were also drawn in later analyses. Using data from international surveys, Ariane Baye and Christian Mansour (2016) showed that between 1995 and 2015, there were more boys among students with the highest test scores. Analyses by Wai et al. (2010), which summarised three decades of the U.S. SAT led to similar conclusions. The researchers noted, however, that between the first analysed decade and the subsequent ones, the gender gap between girls and boys narrowed among top-scoring students in mathematics (although men still prevailed).

Relatively small gender disparities in average scores normally cooccur with bigger differences at the peripheral areas of distributions and lead to different educational decisions. Table 6.1 presents the percentage of girls and boys in the fourth grade in each category of mathematical skills identified in the TIMSS mathematical reasoning test in 2015 and 2019. Girls were slightly more concentrated in the category of average scores, while boys were grouped in the category of the highest and lowest levels of skills (1 and 5 in Table 6.1, respectively).

TABLE 6.1. PERCENTAGE OF BOYS AND GIRLS AT MATHEMATICAL ACHIEVEMENT LEVELS IN THE FOURTH GRADE OF ELEMENTARY SCHOOL IN TIMSS 2015 (N = 4747) AND 2019 (N = 4484)

	2015		2019	
Skill level*	**Girls**	**Boys**	**Girls**	**Boys**
1	3.1%	4.5%	6.7%	7.1%
2	16.4%	16.4%	20.7%	19.1%
3	37.7%	34.6%	39.3%	35%
4	34.3%	33.7%	26.9%	28.8%
5	8.5%	10.8%	6.4%	10%
total	100	100	100	100

Source: TIMSS 2015 i 2019.

* Level 1 represents the lowest level of skills, and level 5 the highest. (More information: *TIMSS 2015. Creating and Interpreting the TIMSS 2015 Contextual Questionnaire Scales; TIMSS 2019. Creating and Interpreting the TIMSS 2019 Contextual Questionnaire Scales*).

The gender differences in Table 6.1 are small, but considering the gender selection at the upper levels of education (women are more likely to choose social sciences and the humanities, whereas men choose technology and engineering), such small differences may predict the withdrawal of girls from mathematics. This may be true for prospective female students of degree programmes that feature a high proportion of mathematical knowledge. It is also worth mentioning that the discrepancies between genders in particular skill levels were greater among third-grade students covered by the TIMSS survey in 2011: 18.3% of boys and about 13% of girls belonged the two highest score categories. However, the study of students of this grade has not been repeated in Poland, so it is difficult to determine whether this is a permanent difference. Researchers do not agree on the reasons for these differences. It should be pointed out, however, that unlike the average (mean) value, which shows a slightly higher share of either gender in particular countries (in some cases there are no differences at all), the predominance of boys in the category of top-performing students is relatively stable, persisting both over time and in comparisons between countries (Baye and Monseur, 2016).

6.1.1. Differences in reading literacy results

Reading comprehension, next to mathematics, is the second key area of school knowledge. Text processing skills are needed not only in Polish language classes but, to almost the same extent, in all other school subjects, including mathematics. Mathematical problems feature written content, which turns into abstract symbols used in more advanced problems only in more advanced curricula. Especially in the early stages of education, school assignments involve both mathematical and language skills. For a long time, comparing the achievements of boys and girls in the reading area was not as controversial as in mathematics. This changed, however, when international skill measurement programmes showed that boys significantly lagged behind girls in reading comprehension. This occurred in almost every country and persisted in the subsequent rounds of performance assessment.

The patterns of achievement in reading comprehension among the youngest students were different from those in mathematical skills. The most important difference was that girls had a significant and consistent advantage over boys. Among the third-graders covered by the 2011 PIRLS study in Poland, girls scored higher on the reading test (on average), similarly to girls from 48 other countries (Konarzewski, 2012). In 2016, when fourth-grade students were assessed, the advantage of Polish girls over boys was 18 points (with a national average of 564 points). Table 6.2 presents this difference by subdomains of reading skills, namely reading and analysing literary texts (including short stories) and functional texts (e.g., press articles and information brochures), which involve the ability to analyse a text in order to understand and interpret it, find connections, and to draw conclusions. A similar advantage was shown by third-grade girls in 2011 achieved, on average, higher results in two main dimensions of reading skills.

TABLE 6.2. AVERAGE SCORES OF FOURTH-GRADE STUDENTS IN READING LITERACY (AIM OF READING) IN PIRLS 2016 (N = 4413)*

Aim	Girls	Boys
literary experience	577 (2.31)	556 (2.4)
acquiring knowledge	568 (2.56)	558 (2.76)

Source: PIRLS 2016.

* The national average was 566 (2.4) for literary experience and 563 (2.4) for acquiring knowledge. Weighted data; standard errors in parentheses.

Overall, girls not only had better skills in technical work on a text (which allowed them to relate content to questions) but they were also more efficient in finding information, more accurate in interpreting the behaviour of characters and analysing their emotions and had a better understanding of the characters' motivations and actions.

The second significant difference between girls and boys in grade four concerned the results of reading performance. In 2016, girls had a clear advantage in higher levels of language proficiency. Table 6.3 shows that more than 66% of girls were classified at the two highest levels of proficiency (55% of boys), and in the highest group, the advantage of girls exceeded five p.p. The percentage of boys in the two lowest reading competence levels, covering the simplest skills of identifying and searching for information in a text, was almost twice as high as that of girls. A similar pattern existed in 2021. Girls here were more among the students with the highest scores too, and considering the two highest skill ranges, the difference between genders reached over 10% pp.

TABLE 6.3. LEVEL OF READING LITERACY SKILLS IN GRADE-FOUR STUDENTS IN 2016 (N = 4413) AND IN 2021 (N = 4179)

	2016		2021	
Skills level*	**Girls**	**Boys**	**Girls**	**Boys**
1	1.6%	2.4%	2%	3.6%
2	6.5%	11.7%	8.6%	13.8%
3	25.5%	30.7%	32%	36.3%
4	43.4%	37.8%	40.4%	35.5%
5	23%	17.4%	17.1%	10.8%
total	100	100	100	100

Source: PIRLS 2016; 2021.

* Level 1 represents the lowest and level 5 the highest level of skills. More information about the scale: Kaźmierczak and Bulkowski, 2023.

The advantage of girls in reading skills was recorded in all countries covered by the PIRLS study in 2016 and 2021, which differed in terms of education systems, social standing of women, and level of economic development. Only the size of the gap between boys and girls was different in the particular countries. It is worth noting that among third-grade students surveyed in Poland in 2011, differences between students were smaller: 33% of girls and 29% of boys were included in the highest skills categories. Due to the lack of further data on this population of students, however, it is difficult to say whether this trend would also continue in the next generation of third graders.

There is no single explanation for gender pattern in reading performance. One hypothesis suggests a link between mental skills (i.e., reading and understanding other people's emotions or empathy) and language skills (Pons et al., 2003; Ebert, 2020). It is assumed that the relationship between the ability to read other people's mental states and linguistic competencies is two-sided. Better language skills make it possible to describe internal emotional states in a more detailed and appealing way, which encourages further interaction and, in turn, develops the ability to "read" the minds of others. Some studies suggest that women have a better ability to identify the mental states of other people based on their behaviour and facial expressions (Calero et al., 2013; Devine and Hughes, 2013), and that these skills are connected to verbal competencies (Ebert, 2020). Therefore, it cannot be ruled out that, on average, the advantage of girls in reading is, regardless of other factors, related to higher skills in interpreting the motivations and emotional states of other people, including literary characters. Current research, however, does not make it possible to determine what the cause or the effect of this relationship is.

Furthermore, it cannot be denied that girls' initial linguistic advantage is reinforced by their social environment, which believes that they are more empathetic than boys, and have well-developed reading habits, and are better at oral and writing tasks. The comparison of mathematics and reading test scores shows that girls at the initial stage of education have a clear advantage in processing written information. This is probably also accompanied by an advantage in non-cognitive skills that support the process of identifying, synthesising, and processing verbal information (e.g., reading emotions and understanding characters' intentions and behaviours). Moreover, the higher the skills needed to solve a word problem, the greater the difference between girls and boys. In mathematics, there was a similar pattern in favour of boys, but the gender disparities were smaller and varied across countries and time. The analysis leads to the conclusion that as boys and girls pass the first school selection threshold, which separates early school from more advanced education at the fourth grade, they differ in their mastery of text-processing skills to a greater extent than mathematical skills. It is likely that the gap between boys and girls does not emerge in this period but begins to take form at the very entry into the education system when boys' school readiness and their reading skills are at a lower level than that of girls (Kopik, 2007).

Students in grades three and four have a lot of time to decide on their further education, and some of them decide on their final examination subjects and university degree programmes. However, these first experiences with specific areas of knowledge and acquired skills may prove formative for the entire education process. Some research suggests that high mathematical skills in preschool correlate with their subsequent increase, while students with lower skills before formal education also show poorer performance at the subsequent levels. Moreover, the advantage in particular skills outlined during the preschool period continues in later years. Verbal competencies, developed before formal learning, are strongly associated with future school achievements in this area. The same is true for mathematical skills (Jordan et al., 2009; Burchinal et al., 2020). The tendency to consolidate the "entry" level of skills in a given domain at later stages of education may affect more than just better or worse grades in individual subjects. Already at the initial stage of education, or just after passing this threshold, at least some students have a degree of awareness of their own competencies as well as specific preferences for subjects and teachers. If students complete a given stage of education with a certain domain-specific confidence, it may not be easy to change this belief in subsequent years. Attitudes towards a given area of knowledge (which I will discuss later) have no less effect on school decisions than skills confirmed by test and examination results.

6.1.2. Girls' and boys' achievements in lower secondary school examinations

In 2002, the lower secondary school (*gimnazjum*)[4] leaving examination became external test assessing students' skills in science and the humanities. In 2012, the exam in mathematics was separated from the science block and students took it as a separate test. This was particularly important because the results determined students' admission to upper secondary schools, which, unlike lower secondary schools, did not apply the principle of catchment areas. They took the exam at the end of the final grade of the 3-year lower secondary school at the age of around 16.

The previously discussed results of mathematical skills tests of third-grade and fourth-grade students did not demonstrate any steady advantage of either gender, but differences were visible in parts of the score distribution. The results of the examination taken at the end of lower secondary school did not deviate from this pattern (Annexe, Table A.5). Girls had slightly lower average scores in mathematics in each year covered by the analysis, and there were fewer of them

4 Lower secondary schools (*gimnazjum*) were 3-year general education programmes for graduates of 6-year primary schools. They existed in the Polish education system between 1999 and 2019.

in the 25% lowest-score group. During the analysed period, the top-scoring group (1%) had slightly fewer girls than boys, while in the 25% lowest-score group, there were slightly more.

More significant and different types of differences between the genders also appeared in the results obtained in Polish language tests. Boys had a lower average score compared to girls, and they were more likely to be in the group with the lowest scores. In the highest score category (1%), there were, depending on year, from 2.6 to 3.4 girls per one boy, while in the 25% highest score group there were slightly fewer: from 1.3 to 2, respectively. This suggests, among other things, that reading comprehension, text analysis, and text interpretation skills differentiate students by gender to a greater extent than mathematical skills.

The performance of students in the last year of lower secondary schools is, therefore, similar to the previously discussed test results in grades three and four. This might mean that patterns formed during the transition from early education to the next level persisted. Based on the existing data, it is not possible to determine in detail the school pathways of specific individuals, although a broader analysis of the entire population shows that boys and girls maintain their competency advantages from the early period of education. Similar conclusions come from the research on the relationships between skills in a given domain and the subsequent results in that same domain (Jordan et al., 2009; Burchinal et al., 2020). This means that the initial advantages (and weaknesses) in a specific field usually prevail at later stages of education.

It is also worth noting that gender disparities in reading comprehension scores do not attract as much attention from social researchers, curriculum experts, and the general public as test performances in mathematics. Indeed, this area has been scrutinised for a long time, and even the smallest differences in tests have provoked animated discussions about their causes and implications for further education and the labour market. Until recently, gender gap in reading comprehension results evidently received less attention. However, when comparative international studies consistently demonstrated that boys predominated among the lower achievers in language tests from an early age, the problem was considered no less important than the differences in mathematics. Developing linguistic competencies, even before starting school, can counteract the marginalisation of boys, who, on average, are additionally hindered by weaker aptitude to the school (appropriate patterns of social relations and appropriate responses to specific situations are positively correlated with school performance). Further research shows that reading comprehension skills are better developed in girls than boys, but the gap narrows in the group of students with higher social status. Lower language skills, and the lack of habits that positively influence their development (e.g., the willingness to read books), were reported among the boys with low social status (Cobb-Clark and Moschion, 2017). On average, boys in this category also have lower cognitive and non-cognitive skills, which reduce their chances of a good start at school and put them in a group of high educational risk.

6.1.3. Polish 15-year-olds and adolescents from other countries

The distribution of results obtained in lower secondary school finals in Poland does not differ significantly from the scores of boys and girls in the international PISA study which covered reading and mathematical skills of 15-year-olds (Sitek, 2019b). Unlike tests assessing the mastering of the core curriculum, the PISA study measures the reading comprehension, mathematics, and science skills needed to operate in society.

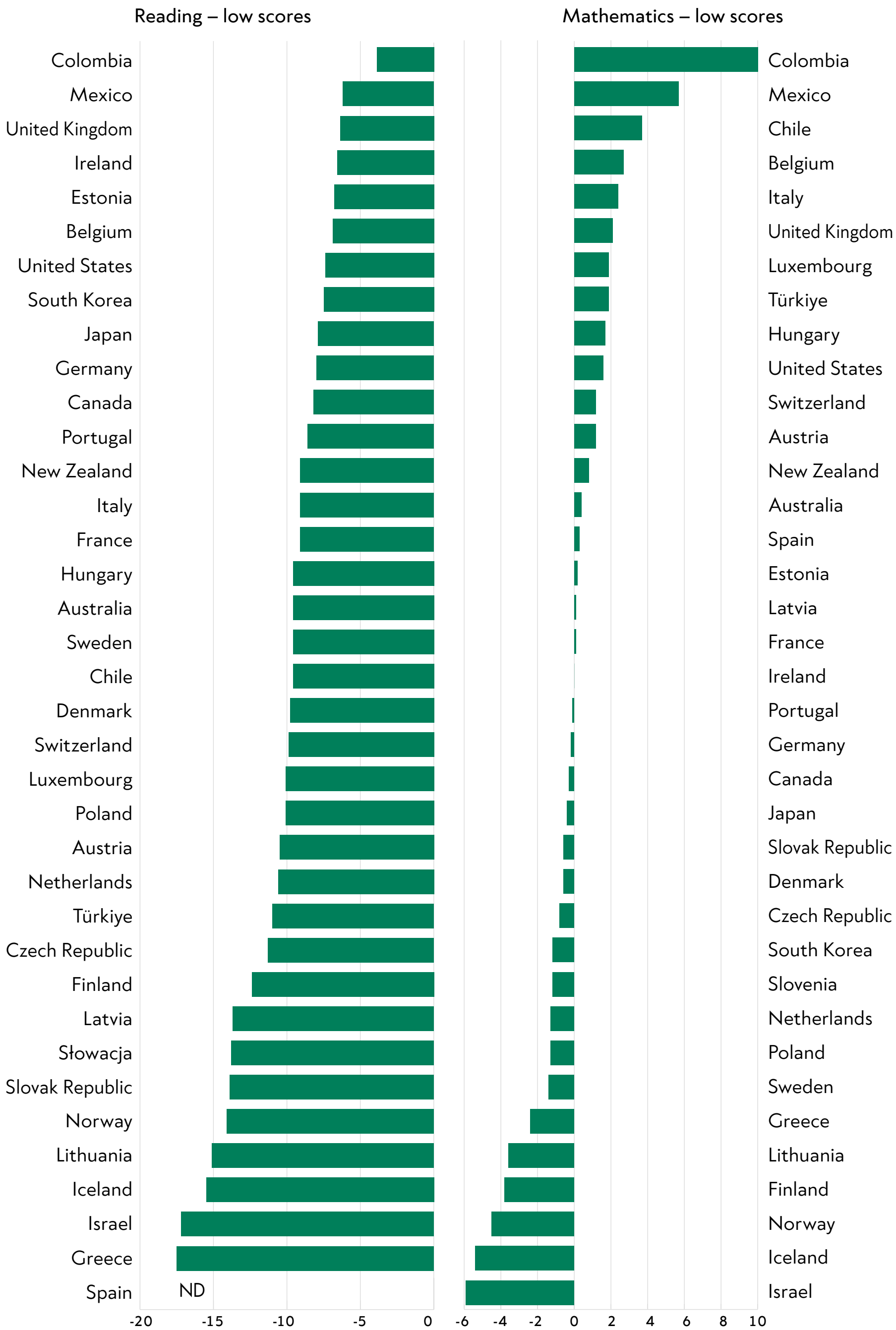
Figure 6.1 shows the difference (expressed in p.p.) between girls and boys on the high and low skill levels of the 2018 PISA scores in mathematics and reading literacy in OECD countries. The highest levels include the top performers in the tests (5 and 6 on a six-point performance scale). This group comprised students who were able to cope with solving complex tasks, choose appropriate strategies for solving the tasks using reasoning, and apply the generalised conclusions to unusual contexts. The lowest level (1 and 2 in the PISA categorisation) comprised students who could solve simple tasks requiring routine procedures and using provided information. The bars to the right and left of zero indicate the size of the advantage for girls, and boys, respectively.

International comparisons make it possible to assess whether gender disparity patterns are similar across countries. Data from PISA shows some relatively consistent patterns. There was a lower share of girls in the lowest-scoring group in reading comprehension tests. In the analysed countries, there were more men in the group with poor text processing performance, albeit these proportions varied between individual countries. In Finland, the difference was 12 p.p. to boys' disadvantage, 17.5 p.p. in Greece and Israel, but only slightly over 6 p.p. in Great Britain and the United States. In all countries, girls had an advantage among high-performing students, although there were also some differences. In Finland, the advantage was the highest at 10 p.p., followed by Estonia and Norway at 6 p.p. Boys' reading comprehension skills were also lower outside OECD countries. They were particularly well represented in the group of weakest students in Qatar and Saudi Arabia (*PISA 2018: Technical Report*).

In OECD countries, in the group of students with high mathematical skills there were, on average, fewer women than men by 2.7 p.p. In some countries, the difference was slightly higher (e.g., in Estonia and Great Britain at 4 p.p.)

or lower (in Iceland and Norway at less than 1 p.p.). In Poland, as in Lithuania and Hungary, girls were fewer than boys by 2 p.p. Overall, however, girls in all OECD countries were underrepresented in the group with high mathematical reasoning skills. Similar proportions could not be applied to the lowest-scoring group, since in some countries it was dominated by boys, in others by girls. The differences were not large, averaging 1.5 p.p.

FIGURE 6.1. DIFFERENCES (IN P.P.) BETWEEN GIRLS AND BOYS IN DIFFERENT CATEGORIES OF LANGUAGE AND MATHEMATICS TEST SCORES (PISA 2018)*



Source: PISA 2018.

* The bars represent the differences in p.p. between girls and boys in two performance categories.
The low scores refer to students who, according to the PISA 2018 classification, reached level 2 at most, have limited text analysis skills, recognise only the main, clearly indicated content, and understand the content literally. Students with high reading comprehension scores (levels 5 and 6) can analyse longer texts and identify nuances. They apply reasoning and better understand the sense of a text.
The detailed characteristics are described in the methodological documentation of the study (*PISA 2018 Technical Report*).

Discrepancies in the scores between countries point to the impact of social, cultural, and institutional factors that may widen or narrow the gap between girls and boys. Gijsbert Stoet et al. hypothesised that the extent of the gender gap may be influenced by the position of women in areas of society other than education, such as politics and the labour market. However, they did not find any convincing evidence of a link between girls' and boys' performance in mathematics tests and gender equality indicators. This hypothesis proved to be incorrect even in the Nordic countries, which score high in gender equality (Stoet et al., 2016). Other researchers argued that in countries where gender inequalities are lower, the economy is more developed, and women have more opportunities for social participation, the gender gap in mathematical skills is wider. Ming-Te Wang, Jacquelynne S. Eccles, and Sarah Kenny (2013) suggest that the axionormative transformations taking place in Western societies may contribute to the reinforcement of traditional educational choices for women and men. The ability to pursue educational and professional careers according to individual interests, rather than under economic pressure, may be associated with women's participation in traditionally masculine fields. Studies show that in poorer countries with less developed social spheres, which generally translate into reduced economic security, the proportion of women in STEM (science, technology, engineering, mathematics) is higher than in countries that are developed more economically (Stoet et al., 2016). Quentin Lippmann and Claudia Senik (2018) observed a similar pattern when comparing the mathematical skills of young people from the former East and West Germany. In the eastern part, gender disparities were smaller in these skills, and girls were not as afraid of mathematics as their peers in the western part of the country. This is consistent with the findings on women's competitiveness, self-confidence, willingness to work in the new technology sector (Napp and Breda, 2019), and fear of failure (Borgonovi and Han, 2021). All of these characteristics were less pronounced among women in more developed countries with higher levels of gender equality indicators than in those with less prosperous economies.

6.2. Gender differences in secondary school exams

The upper secondary school leaving examination (*matura*) is the last and most important step on the way to higher education and, at the same time, a summary of earlier achievements and educational choices. In recent years, the form of this exam in Poland has undergone various changes, among which was shifting mathematics into the pool of compulsory subjects as of the 2009/2010 school year (previously, the choice was optional).

External final exams for upper secondary schools were held for the first time in 2005. In the written part, students were required to take a test in Polish language and literature, a modern foreign language, and a selected subject in the field of the humanities, social sciences, or natural science and mathematics. If they decided to choose mathematics as their third compulsory exam subject, they could take it at a standard or advanced level. In addition, secondary school leavers could take up to three exams in additional subjects at the advanced level. In 2005, mathematics was the most frequently chosen third compulsory subject (25.5% of secondary school leavers), slightly ahead of geography (25%), and biology (23%), whereas 2.9% of students decided to take it as an additional subject at an advanced level (CKE, *Results of the final secondary school examination in 2005*).

This considerably high interest in mathematics lasted only until the next school year or possibly even shorter, until the results of the 2005 finals were published. These showed that a relatively large group of students failed the mathematics exam. Relatively, because in the first year of the external secondary school finals, an average of 85% of students who took it passed (i.e., obtained a minimum of 30% of points) but maths had the weakest result compared to other subjects, where scores exceeded 90%. One of the reasons for the lower pass rate in mathematics chosen voluntarily as a compulsory examination from the pool of school subjects, was the variation in success rates between different types of schools. Students at specialised secondary schools (*licea profilowane*) did particularly poorly, with 41% of students failing the exam compared to 6.3% of students at general secondary schools. There was also a similar difference between secondary schools where mathematics was taken as an additional subject. Students at general secondary schools scored an average of 58% of points, and those at specialised schools scored 34% (CKE, *Results of the final secondary school examination in 2005*).

It is likely that the lower level of success in the mathematics exams was the reason why the popularity of this subject, taken voluntarily, dropped from first to third place as early as 2006 (selected by 18% of secondary school leavers). While, in 2005, it was chosen by 27% of students, a year later it dropped to 21%.

In specialised secondary schools, the fall was even greater, dropping from second place in 2005 to fourth in 2006 (21% and 11% respectively). Subsequently, geography rose in the examination popularity as the most frequently chosen compulsory subject (29% of all students). It was especially popular in technical secondary schools, where it was chosen by 45% of school leavers in comparison to 14% who chose mathematics.

It can be assumed that the lower pass rate in mathematics compared to other subjects contributed to a decline in its popularity. The exam was no longer perceived as easy, for which a student had to work hard to obtain the required minimum pass score. In subsequent years, mathematics was chosen by students who were better prepared and less likely to rely on luck (CKE, *Results of the final secondary school examination in 2005*). This was indicated, among other things, by an increase in the pass rate. In 2006, a total of 93% of students passed the final exam in mathematics (compared to 85% the previous year). There was an improvement in both specialised secondary schools (from 60% in 2005 to 80% in 2006) and general secondary schools (from 91% to 97%). Geography also proved to be a good choice, with an average of 95% of students passing the exam.

Mathematics continued to be a subject with a relatively lower pass rate. Almost half of all the failures in upper secondary school finals were due to failure in this exam. Making mathematics a compulsory subject for all students in 2010 did not change this pattern. In the first year following this change, 42% of failures were the result of not meeting the score threshold in mathematics at basic level. At the time, the pass rate for this subject was 87% and was clearly lower in comparison to the Polish language, which was passed by 95% of secondary school leavers. These indicators remained at a similar level in the following years.

Even if a student obtained a good result in the final examination at standard level, it may not have been enough to exceed the admittance thresholds for degree programmes involving a high share of mathematics. In general, to be admitted, it was necessary to sit the exam at advanced level. Until 2015, choosing at least one subject taught at advanced level from outside the compulsory pool was a student's right. After that year, it became an obligation. Formally speaking, students had to decide on a subject taught at an advanced level in their last year of upper secondary school. Before 2015, on average, 15–18% of all secondary school leavers chose mathematics at advanced level (Polish language at advanced level was chosen by 9 to 10%). In 2015, when students had to take the advanced level final exam of their choice, 27% of all students chose mathematics. Polish language was chosen by 21% and geography by 22% (CKE, *Report on the final upper secondary school examination 2015*). Similar choice patterns continued in the following years, and were almost identical in 2022 (CKE, *Report on the final upper secondary school examination in 2022*).

The attitudes of students to mathematics have been ambivalent. On the one hand, the majority of final upper-secondary exam failures have been caused by failing this subject at standard level, while on the other, students often choose it as an additional optional subject. The change that required students to take a subject at an advanced level may have contributed to this ambivalence. Mathematics became an attractive choice for both highly skilled students planning to take a maths-oriented majors at the tertiary level, and for those who only wanted to fulfil the examination requirement. For the representatives of the latter group, the costs of making such a decision have been low, since the finals at advanced level are passed by everyone who takes them, not just those who exceed a particular score threshold. The introduction of a score threshold may change the decisions of students, especially low-performing ones, who count on a lucky selection of test questions rather than their own skills.

A comparison of mathematics results in the final exams among secondary school students who took the subject only at standard level (Annexe, Table A.6) shows that between 2014 and 2016 the group of students with both the highest and average results included more women, while the group with the lowest results was dominated by men.

However, the filter for access to studies requiring strong mathematical skills is not the final exam taken at standard level, but at the advanced level. Mathematics, along with Polish, biology, and physics, was only one of many subjects that students could choose at the advanced level of the *matura* exam. The differences between women and men who chose this subject were clear and consistent over time (Table 6.4). During the analysed period (2012–2020), the proportion of girls taking the advanced mathematics exam was, on average, almost twice as low as that of boys – in 2020, 36.1% of students taking the upper--secondary school exam decided to take the extended *matura* exam in mathematics compared to 19.8% of female students. Since the introduction of the compulsory advanced-level exam, the gender disparity has remained strikingly similar.

TABLE 6.4. PERCENTAGE OF GIRLS AND BOYS TAKING THE ADVANCED MATHS EXAM AT THE END OF SECONDARY SCHOOL BETWEEN 2012 AND 2020

Year	Girls	Boys
2012	10.3%	19.8%
2014	13%	18.8%
2015*	20.5%	40.3%
2016	18.9%	38.3%
2017	18.3%	36.9%
2018	18.7%	36.5%
2019	18.6%	36%
2020	19.8%	36.1%

Source: CKE, reports from final examinations for higher secondary school between 2012 and 2020.

* Since 2015, there has been an obligation to take exams in selected subjects at advanced level.

The choice of the subject taught at advanced level by students who are planning further education after secondary school may be related to their future studies and initial career plans. Resigning from the advanced level examination in mathematics is a signal that the student is not likely to start studies based on knowledge in this area or link their professional career with this field. Women make such declarations more often.

I will discuss the social and psychological determinants concerning these issues in the subsequent chapters. For now, however, it is worth noting the factor that influences decisions to take the exam in mathematics at advanced level, which is mathematical skills. Indeed, it is a student's level of knowledge that should determine whether he or she takes a given examination at advanced level: the higher the skills in a given area, the greater the likelihood of taking a more challenging exam. Analyses of the results in secondary school finals confirmed the hypothesis that better results in mathematics obtained by women and men at standard level increased the odds that they would sit the exam at advanced level (Zawistowska and Sadowski, 2019). However, gender significantly influenced the choices and girls were less likely to take the advanced mathematics exam, even after taking into account the results of standard mathematics exams.

Also other studies show that mathematical skills are not the only factor that determines the choice of specialisations and courses with a high proportion of mathematics in upper-secondary school and higher education institutions. Nor do they clearly explain the difference between women and men in this respect (Wang et al., 2013). The researchers argue that, to some extent, the choice is influenced by language skills, which, alongside mathematics, occupy a central place in many education systems. However, having high language skills may influence women's and men's decisions in a different way. Girls with better verbal than mathematical skills are more likely to choose non-technical fields of study than boys with the same skill profile. Despite high verbal skills, boys are more likely than girls to choose majors involving mathematics and less likely to choose the humanities (Webb et al., 2002). A similar relationship can also be observed among Polish secondary school leavers. High scores in the Polish language exam strongly reduced the likelihood that women would take the advanced mathematics exam in comparison to men (Zawistowska and Sadowski, 2019).

If one attempts to generalise these findings, it can be concluded that high levels of language skills restrict career plans related to mathematics for women to a greater extent than for men. The reasons for this can be traced back to the structure of the school system as such. Ming-Te Wang et al. (2013) argue that the withdrawal of women with high skills from areas that involve mathematics is a result of the availability of multiple pathways related to the humanities and social sciences. Schools offer students a wide range of subjects and specialisations, where mathematics is only one option. The availability of subjects in the fields of social sciences, the humanities, and science may further encourage women to choose from these subjects, regardless of whether they have, on average, much better verbal skills. In general, women score higher than men in all school subjects; social sciences, the humanities, and science alike (Skórska et al., 2014). Considering only school results, women could specialise in a variety of subjects, including science, but they consistently avoid mathematics, even if they are skilled in this area. It is possible that, to some extent, this is affected by the freedom of choice in school subjects, which at the upper stage of education, allows women to opt out of mathematics or minimise the amount of time spent studying it.

If not maths, then what?

We already know that women were less likely to take the final secondary school examination in mathematics at advanced level. Which subjects were they more willing to choose? In light of the previously cited data, which demonstrated the advantage of girls in reading comprehension tests and the Polish language examination results, it is not surprising that the advanced-level finals in Polish were particularly popular among them (Annexe, Table A.7). Analyses of subjects taken in the secondary school exams in 2020 and 2022 suggest that female students were three times more likely to choose the exam in Polish language than men. Also noteworthy are the different patterns in science subjects. Women were more likely than boys to take exams in biology and chemistry, but not in physics, where four times as many men chose this subject. Moreover, women were less likely to choose both physics and mathematics at advanced level. In 2018, 15% of them sat both exams in comparison to 32% of boys. The chances of taking the exam in computer science were also considerably different. This subject, like no other in the secondary school final examinations, combines mathematical skills with practical tasks performed using a computer. Students are required to create and analyse algorithms using databases and translating decisions into a language that is understandable to a compiler. In recent years, few students have sat this exam: a little over 3% of all secondary school leavers. In 2022, this group was 8.5% women, and 8.9% two years earlier (CKE, *Report on the final upper secondary school examination in 2020*, and *Report on the final upper secondary school examination in 2022*). The extent of this gap, apart from the potential difference in actual skills, may also be influenced by the different perceptions of students' own competencies. Research conducted among 15-year-olds in 2018 showed that boys presented higher self-perceived technological aptitude, were more likely to declare that they could independently solve problems using computer hardware and positioned themselves in the role of experts/advisors in matters related to IT (*PISA 2018 Results (Volume II): Where All Students Can Succeed*). This belief may be partly linkedwith boys' experience since they enter the world of computers earlier than girls. According to the PISA study, more than half of boys have been using digital devices since they were six (only one-third of girls made similar statements). Proficiency in using computers does not necessarily translate directly into the subsequent choice of an IT major, but it does affect self-confidence in using this device.

There are also some interesting gender differences in the choice of science--related subjects in secondary school exit exams. Analyses regarding differences in educational decisions often treat physics, computer science, biology, and chemistry equally as fields belonging to one extensive STEM category. Gender preferences on secondary school exit exams (Annexe, Table A.7) show that each of these subjects "attracts" girls and boys to a different degree. Each requires different skills and competencies, in addition to differing in how they are perceived by the academic milieu (Leslie et al., 2015). A survey of higher education staff showed that academic employees were convinced that disciplines in which success can be achieved thanks to talent were suitable for men than women, who preferred to be on career paths where success depended on commitment and hard work. Mathematics, physics, and computer engineering were considered to be fields requiring talent, whereas biology and chemistry were considered to be fields in which this factor did not play such an important role.

Similar findings were reported by Thomas Breda and Clotilde Napp (2019) who demonstrated that 15-year-old girls explained their failure by lack of talent more often than boys. This is an important difference because talent is often perceived as an innate, unchangeable trait that cannot be improved even through hard work. The belief that pursuing mathematics-oriented paths is mostly dependent on talent may be a convenient excuse for giving up mathematics by people who experience temporary failures.

Other explanations for the preferences of women and men in the area of science refer to the stereotypical perception of such domains. Physics, in the eyes of the representatives of these disciplines, involves working with inanimate matter and randomly moving particles. Biology, on the other hand, involves interaction with living cells and animals, and according to scientists, research conducted within this discipline has greater social application (Ecklund et al., 2012). Such self-stereotypes that exist among representatives of particular fields may have emerged before researchers began working in science on a practical level, or they may be the product of later observations of reality and subsequent experience. The hypothesis that the people's imagination of certain areas of science (or some of their characteristics) has a discouraging effect on women cannot be ruled out. Perhaps the different subject matter of various science domains, as well as the research instruments, play a certain role in the gender selection process. Typical science props are made of thin glass. They look tidy and elegant in a school laboratory, where students are required to exercise great caution and manual dexterity. Small, fragile instruments used to measure correct amounts of preparations, liquids closed in miniature bottles organised in compartments, or the microscope, are all props in a science laboratory that correspond to features stereotypically attributed to women. Accuracy, attentiveness, and efficiency in manual work are commonly believed to be feminine. On the other hand, aids in the physical lab have different characteristics. These are often massive devices enclosed in metal or plastic cases, entwined with cables, wires and coils. Mechanical tracks supported by carts on bearings, electroscopes or capacitors in school physics laboratories are, at least to some extent, a metaphorical representation of the male world. Semiconductors and rectifiers are not part of the decor of the average adolescent woman facing a dilemma regarding her final exams and the course of her further education.

In the context of making educational decisions, aesthetics seems too trivial a factor when compared to skills acquired over many years. However, there is reason to believe that the aesthetic dimension does matter. People have a tendency to avoid environments in which they feel uncomfortable or alienated. Sapna Cheryan et al. (2009) demonstrated that certain elements stereotypically attributed to IT can intensify such feelings in women. The study found that when young women were in a computer room decorated with items specific to the geek culture, they were significantly less likely to declare an interest in computing or the desire to pursue a career in this field than women in a neutral room. Posters from science fiction films, fast food containers, video games, and electronic gadgets had a stronger impact on women's opinions than direct communication that encouraged them to study computer science. Interestingly, the presence of geeky elements had the opposite effect on men, who were more likely to declare an interest in computer science in such an environment than in a neutral room. The respondents agreed that the style of the geeky room was masculinised and could have a discouraging effect on women only. This suggests that stereotypical perceptions about the lifestyles and habits of representatives of certain scientific fields may deter women. The research also showed that when deciding on a field of study, the skills one possesses are only one of many factors. Beliefs about one's future education and working environment based on images, perceptions, stereotypes, and circulating opinions may be equally important.

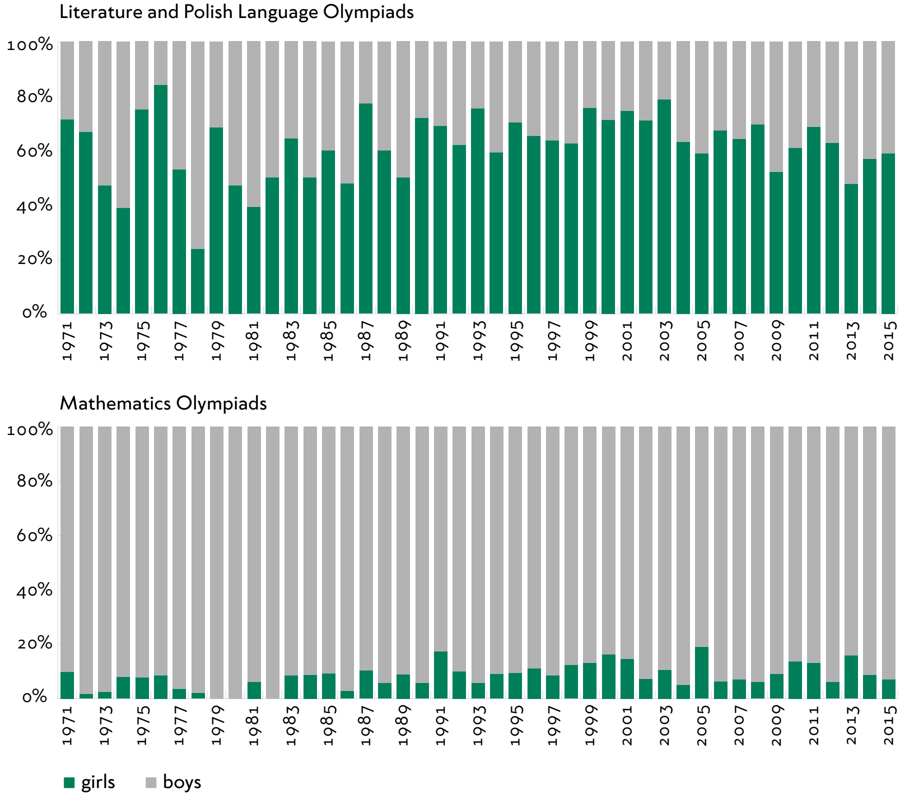
To conclude this section, it is also worth pointing out that students' decisions concerning secondary final examination subjects, which are an important part of the admission to tertiary level, are the result of years of accumulated experience, skills, and aspirations as well as fears, anxieties, beliefs and stereotypes. Even if students make a formal declaration concerning the choice of specific examinations at the final stage of secondary school, for many of them, the decision was made much earlier. It was affected by experience built up over the years, a developing sense of competence or helplessness, and attitudes towards specific fields of study, which formed in successive grades. The final choice of the upper-secondary school examinations is only a formal conclusion of this long-term process.

6.3. Participants of maths and language Olympiads

Analyses demonstrate that women are a minority in the group of male and female students who perform highly in aptitude tests and compulsory exams in mathematics. Given an alternative, they are less likely to choose mathematics as a subject in their final secondary school examinations. Let us see how this pattern changes when the student population is narrowed down to the most talented group, albeit not those who achieve the highest examination scores but those who go far beyond the requirements of the standard curriculum and test their skills in mathematics at subject Olympiads. These competitions are like sieves with very small eyes through which only the most talented, diligent, and committed students can pass. Research also indicates that participation in Olympiads is determined not only by intellectual criteria, but also by social, material, and cultural status (Lipovska and Fischer, 2016). Although mathematical talent can erupt anywhere, adequate educational resources provided by well-educated parents can help to fully develop it. Among the individual factors that increase the chances of participating in Olympiads, an important one is a propensity to risk-taking and competitiveness (Niederle and Vesterlund, 2010). The mechanism of selection and self-selection of participants of these contests is not recognised in details, but it is highly probable that they differ in some characteristics even from those high-achieving students who do not take part in such events.

Gender appears to be a significant differentiating factor between the participants of subject Olympiads. The top panel of Figure 6.2 shows the percentage of girls and boys among the winners of the Literature and Language Olympiads from 1971 to 2015, and the bottom panel shows the same information about the winners of the Mathematics Olympiads.

FIGURE 6.2. PERCENTAGE OF GIRLS AND BOYS AMONG THE WINNERS OF MATHEMATICS OLYMPIADS, AND LITERATURE AND POLISH LANGUAGE OLYMPIADS BETWEEN 1971 AND 2015



Source: Internet compilation of the Literature and Polish Language Olympiads (bit.ly/41O9L7j) and the Mathematics Olympiads (om.mimuw.edu.pl).

During the decades covered by the analysis, there was overwhelming number of boys among the winners of the Mathematics Olympiads. The changes in the organisation of the secondary school finals, the growing demand for mathematical skills, and the ongoing gender emancipation processes that took place during this period did not reduce this difference. An even more striking example is the Physics Olympiads[5]. Between 1991 and 2001, there were only two girls among 165 winners and only one among 215 winners between 2005 and 2019. Moreover, there were only a few girls among all the finalists.

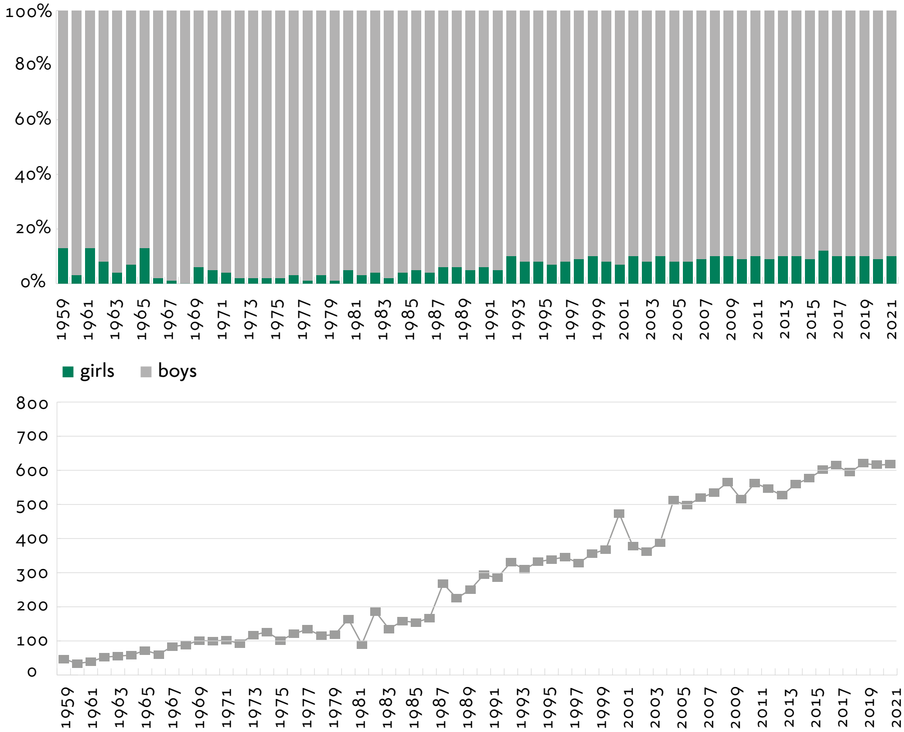
5 www.kgof.edu.pl/?aktualnosci

The gender proportion among the participants of the Polish Literature and Language Olympiad was different. The percentage of girls varied from year to year, but in most competitions, they constituted more than half of the winners. However, this proportion was not a reversal of the report from the mathematics contests. Moreover, share of girls in the period covered by the analysis (1971–2015) was not as large as could be expected based on their significantly higher results in the Polish language exams and reading comprehension tests. This suggest that the Olympiad participants are not a representative sample of students with high language skills, but they probably have additional traits or skills that encourage them to join such contests.

Similar gender disparities could also be observed in international mathematical competitions (Figure 6.3). Boys constituted the majority of participants in the International Mathematical Olympiads (organised since 1959), which are open to winners of national contests. In 2017, out of 111 teams from different countries around the world, only forty-eight had a girl. The exception was the completely feminised Liechtenstein team as well as the teams from Botswana, Colombia, and Venezuela, in which the gender proportions were similar (Andreescu et al., 2008). On average, the uneven proportions persisted over the years, despite the clearly growing overall number of participants.

The status of a top student is usually not enough to become a winner or finalist. Contests are a voluntary way to verify one's knowledge and are inherently connected with rivalry, risk-taking and wanting to test oneself. For many young people, participating in such contests means having to face failure, which will inevitably happen to some participants of these selective ventures. Research shows that mathematics contests attract competitive people who are more willing to take risks (Niederle and Vesterlund, 2010; Buser et al., 2014; Buser et al., 2017). This is the same predisposition which facilitates making decisions about choosing scientific and technical specialisations, which involve greater selection. For example, Thomas Buser et al. (2014) demonstrated that girls were less likely to pursue these fields in general, but that this was more likely to happen among women who were competitive. Moreover, other research suggests that aversion to risk may have a negative impact on test scores. An analysis of admission exams to several Finnish universities of economics showed that women were more likely than men to omit questions which they did not how to answer, instead of using a strategy of randomly choosing a reply. The authors of the study suggest that this was not for lack of skills, but because of the way the test scores were counted. An incorrect answer was tantamount to losing a point, whereas its absence had no negative impact on the final result. Nonetheless, by omitting questions more often, female candidates obtained, on average, lower scores on the exam than male candidates and were less likely to be admitted to university (Pekkarinen, 2015).

FIGURE 6.3. PERCENTAGE OF GIRLS AND BOYS AMONG PARTICIPANTS OF INTERNATIONAL MATHEMATICAL OLYMPIADS (UPPER FIGURE) AND TOTAL NUMBER OF PARTICIPANTS (LOWER FIGURE) BETWEEN 1959 AND 2021



Source: Online data of International Mathematical Olympiads.

Women are more averse to risk than men and, unlike men, avoid competitiveness. Such an attitude may encourage withdrawal from activities which involve constant competition and uncertainty. This includes mathematics contests. It is possible that some female students with sufficient competencies in the field are subject to a self-selection process resulting from a lower tolerance of uncertainty and emotional difficulties in coping with potential failure or pressure. It is not known, however, whether the same criteria distinguish boys who enter mathematics competitions from those who do not.

The second explanation for gender disparities among people with above--average skills refers to the hypothesis of greater variance in some characteristics among men (O'Dea et al., 2018). This relates to the fact that in many respects, including personality and cognitive characteristics, men are more diverse than women and, therefore, are more numerous among extremely high and low values of the intensity of such characteristics. The pattern of greater variance among men has not yet been fully explained. Some researchers associate it with a more frequent incidence of traits that support the development of high mathematical skills (including the ability to organise, find connections, systematise, and detect patterns and rules). On average, the level of these skills is lower in women, whereas more pronounced are their social abilities, as well as verbal and non-verbal communication skills. In this way, differences among skills were explainedat the beginning of the 21st century, a team of psychologists led by Simon Baron-Cohen. They formulated a hypothesis that people can be situated on a continuum whose ends are determined by well-developed analysis and construction skills on the one hand, and high empathy on the other (Greenberg et al., 2018). The researchers noticed that men were more often represented in the group of those who are better at thinking through the prism of patterns and systems but are worse at interpersonal relationships. In some cases, these features overlap with symptoms of the autism spectrum disorder. This last assumption, as well as connecting gender dissimilarities with the different "male" and "female" brain, has not yet been empirically verified, while the hypothesis of greater variability of a given feature in men requires further examination.

6.4. Summary

Secondary schools determine further educational biographies of students for two reasons. First, it is at this stage that young people who are planning further education make formal decisions about the future. By choosing a given specialisation and subjects for their final upper secondary school exams, male and female students declare which course of study they are interested in and which industries they would like to work in in the future. For example, the mathematics exam taken at advanced level plays a key role for those who consider studying engineering and technical subjects and are planning a career in these fields. Secondly, decisions about the choice of specialisation in secondary school are made by the students independently. Young people can choose subjects they are more interested in, which they did not have the opportunity to do at earlier stages of their education. Moreover, the examination subjects at lower levels (sixth grade, lower secondary and, after the reform of Polish education system, eighth grade) have been compulsory, whereas the actual final upper secondary exam is not.

Having attended the same educational institution, girls and boys make different decisions concerning the final examination subjects. On average, twice as many boys take exams in mathematics and more than twice as many girls take them in the Polish language. Different preferences have also been evident in science subjects. Girls have been more likely to take biology and chemistry, while physics and computer science have clearly been attracting boys.

If students' decisions about the subjects they take in upper secondary school finals depended solely on their skill level, they should be strictly reflected in their achievements at the school performance at different levels. However, this can only explain why more girls choose the Polish language – as girls show high skills in this field from the early stage of education. In the case of mathematics, the matter is more complicated. Research and analyses presented in this chapter show that gender disparities are, on average, higher in reading comprehension than in mathematics. Girls at particular levels of education and, possibly, even before starting school, are better at processing the information they read, are able to interpret it, identify deeper meanings, and draw conclusions. Boys have deficiencies in this respect already after the early school stage, and it is likely that they are, on average, less prepared to do so after completing preschool. Language skills differentiate students by gender more strongly and more consistently than mathematical skills. This is apparent in comparisons between countries, which take into account diverse social, economic, and educational systems. It is also the case with subsequent rounds of cyclical research, where the same methodology is used. Moreover, it is also evident in major examinations at the lower and upper stages of education. As far as mathematical skills are concerned, the conclusions are neither as clear nor consistent over time. Some analyses demonstrate a small and variable greater success of girls in the international dimension, whereas others, greater success of boys (Mullis et al., 2000; Else-Quest et al., 2010).

Overall, the difference in mathematics is smaller than in reading comprehension. Nonetheless, in the selection for engineering and technical studies, a more important category is students with high results in mathematics. This group forms a pool of future engineers and specialists in narrow fields that require high mathematical competencies. Therefore, it is the focus of researchers who study the issue of selecting degree programmes and subsequent careers. Research shows that in the group of top-scoring students (in both high-stakes and low-stakes tests), female students are less represented, and the better the results in the group, the percentage of women is lower. This is a relatively persistent pattern in various countries, recorded both in the past and the present (Reilly et al., 2018). The advantage of men is also apparent in the highly selective category of participants in national and international contests in mathematics.

Following on the above, it seems that the predominance of men among students with high scores in mathematics explains their subsequent overrepresentation in mathematics-oriented paths. However, this explains only part of the gender disparities. Research suggest that among students (of both genders) with the same or similar skills, men are more likely to choose studies focussing on mathematics (Niederle and Vesterlund, 2011). Having specific skills is a prerequisite for choosing mathematics, but there are other aspects involved. The development of such skills is influenced by various factors which affect students through the immediate social environment, peers and teachers, and wider social groups. Emotions, mindsets and attitudes, which are shaped during many years of interaction with mathematics, also have a significant impact. In the next chapter, I will discuss the influence of these factors on decisions related to mathematics and consider to what extent they might be a reason for women's lower interest in mathematics-related careers.

7

Gender and the attitude to mathematics and reading

Some education-related decisions are made on the basis of rational, albeit not always conscious, analyses of economic benefits. Others may result from personal interests and passions in a specific domain, or conversely, from disliking it. Societal pressure and the desire to model oneself on one's peers may also play a role. Among these specific determinants of school choices, of particular importance are the beliefs that individuals hold about themselves, their understanding of their strenghts and weaknesses, and their perceived ability to achieve goals. These self-perceptions are the building blocks of the concept of self. When individuals are aware of them at least to some extent, they can use them to articulate and describe their own abilities, which are important in the process of developing, making, and implementing one's goals. The way individuals perceive themselves and their capabilities affects the level of motivation to act and the emotions towards an object or phenomenon. It also determines whether or not an individual will fulfil his or her intentions. Albert Bandura (1997) added a number of other factors contributing to the achievement of goals, including the degree of commitment to a particular activity, resistance to failure, and ways of overcoming setbacks as well as the style of facing adversity and dealing with emotional difficulties. Bandura's theory of perceived self-efficacy and other approaches to the issue of motivation (Eccles, 1994; Wigfield and Eccles, 2002) may help to better understand the differences in the educational decisions of women and men. While test scores affect such choices, believing in own abilities and emotional attitudes towards a domain may influence goal attainment to a greater extent than performance (Bandura, 1997). Taking into account the importance of an individual's about themselves in making and implementing decisions, in this chapter, I will compare students' beliefs about their own skills in reading and mathematics. As in the previous chapters, I will use surveys conducted on large samples of students, where older students were asked to assess their own skills in a particular area, while younger students were also asked about their attitudes towards lessons and teachers. The results reflect the students' subjective perception of their own skills. All analyses in this chapter concern Polish students and attitudes toward domains.

7.1. Beliefs in own abilities and schooling choices

According to Bandura (1997), belief in one's self-efficacy develops based on four sources of information. Each of these sources helps individuals form an idea of their capabilities in a different way. In this respect, personal achievements have the greatest influence on the definition of self. Actual success provides indisputable proof of one's own strength, skills, and determination. Failures on the way to fulfilling a goal, in particular those suffered at an early stage, will have a demotivating effect. Setbacks will discourage further effort and, if repeated, the goal will no longer be an object of aspiration. It is easy to obtain this kind of information in a school context. Grades and results of tests and examinations provide students with information about their skills and, according to Bandura, determine beliefs about themselves and, subsequently, their actions. The researcher emphasises that the effectiveness of personal experience of success or failure in constructing self-beliefs results mainly from knowledge acquired while performing specific actions. By achieving a goal, an individual learns what helped him or her succeed, and what methods and cognitive tools brought them to a given place. Knowledge of the methods and means required to achieve success reinforces one's self-efficacy beliefs better than achievements that were not preceded by adequate effort. The achievement of a high test score that is preceded by thorough preparation will, therefore, be a better lesson about oneself and one's skills than a grade that was easy to obtain.

Another source of information about one's own capabilities is comparing oneself with people in one's immediate surroundings. Individuals use others as a point of reference to formulate beliefs about themselves. The school environment enables for many such comparisons. The presence of other students, whose skills and achievements are measured on the same scale, makes it possible to check whether one performs "better" or "worse" than others in a given subject. Bandura argues that the sense of efficacy increases when one performs better in comparison with others and decreases when others have done better. A particular benefit to the sense of efficacy is knowing that the successful people you compare yourself to are similar to you. This reinforces the belief that if others have succeeded, I can do so too. The influence of such people on forming a sense of efficacy may be important when an individual is uncertain of his or her own competencies and doubts his or her ability to succeed. In this case, decisions to act and the effectiveness of doing so may depend to a greater extent on "significant others". The impact of such role models on unconventional educational choices, which are burdened by uncertainty, has been described by Amy L. Zeldin and Frank Pajares (2000). Their study of women working in occupations requiring high mathematical skills showed that their decision to choose a profession was facilitated by the experience of others. The women were surrounded by people who had a background in mathematics and worked in mathematics-related professions. In general, these were immediate family members or distant relatives. Such close ones inspired women during socialisation and provided reliable information on how to pursue a career in male-dominated fields. Such support from a more experienced role model can be useful when individuals become uncertain about their competencies and, subsequently, face a higher risk of failure.

The existence of role models is linked to the third source of building the self-beliefs specified by Bandura (1997). This comprises verbal motivational messages about the individual and support received from people in one's surroundings, which are factors that reinforce one's self-efficacy beliefs. People who are effectively motivated are able to organise additional resources, gain confidence in success and are not discouraged by setbacks. However, Bandura points out that the impact of a supportive environment on self-image is relatively small since verbal persuasion affects mainly people who have high confidence in their skills and have experienced success. This would mean that support shown to individuals may not be as effective in building a sense of agency as an opportunity to directly observe other experts. Bandura also emphasises that the overall interaction with significant others and their level of social attractiveness in the eyes of an individual are more important than verbal messages.

Emotions play an equally important role in shaping beliefs about what is achievable in the context of educational decisions. Unpleasant emotions triggered by a particular activity are a strong discouraging stimulus, a sign of discomfort or threat. On the other hand, the sense of self-efficacy is affected in a different way when an individual succeeds or expects to succeed. In the case of mathematics, which can trigger difficult emotions, students with high skills, who like this subject, may create positive associations and build up experiences that encourage self-efficacy. The situation is different for students who experience mathematical anxiety (often expressed as physiological reactions such as accelerated heart rate and sweating of the palms). For these students, a subjective sense of competency is low, possibly linked to a desire to avoid mathematics and the uncomfortable stimuli it provides.

Jacquelynne Eccles et al. described the process of achieving individual goals in a different way (Eccles, 1994; Wigfield and Eccles, 2020). The researcher offered proposed a multifaceted approach which connects questions of motivation, beliefs, values, and goals with social impact. This approach assumes that the motivation to accomplish goals is conditioned by two factors. The first is the subjective assessment of chances of success; the higher an individual estimates the feasibility of achieving the goal, the more likely they are to activate the resources needed to attain it. Thus, as in Bandura's theory, the subjective assessment of the chances of success depends not as much on specific skills as on attitudes. Determination to act is lower when an individual does not have the conviction that he or she is sufficiently competent to succeed. The lack of such confidence has a negative effect on assessing the chances of success.

The second group of factors contributing to the achievement of goals is the rank, usefulness, and the importance attributed to a particular goal. Objects that are perceived as attractive or valuable will encourage individuals to engage, even if the costs of achieving success are high, whereas a lower value attached to goal will have the opposite effect. An example of such an impact can be found among students who question the point of learning mathematics claiming that their knowledge of the subject will not be highly useful in their later educational and professional lives. Hence, it is important to understand what makes an individual see a specific field as important and worthwhile. Eccles et al. argue that during the formation of such a hierarchy, the most important factor is the upbringing process. The social environment may support or depreciate certain values and creates conditions for building long-term goals in life based on specific scenarios, with the most typical example being the high educational aspirations of the children of well-educated parents. Experience gathered in the education process can, however, alter these original values shaped at home. Allan Wigfield and Jacquelynne Eccles (2002) have observed a specific evolution of the value attributed to different school subjects, including mathematics. This field is valued by children in younger grades, while its rank decreases among older students, who have become more critical of their own skills and ability to succeed in the subject. This observation may be relevant in the context of the choices made by students at key moments in their educational and professional careers. The older students have become more self-critical of their abilities, while at the same time, they have greater freedom to choose a specialisation field. If students have less motivation to learn and do not value mathematics as highly as they did at previous stages of their education, they may choose a different specialisation when an opportunity arises (e.g., in secondary school).

Not all the components of the expectations-values model posited by Eccles et al. (1994; 2002) have passed empirical tests. The source of the variability in this concept turned out to be, among other things, the loose relationship between declared goals and their actual fulfilment, which has also been demonstrated in research on attitudes. Just as not all attitudes will go on to be realised, the high priority attached to certain activities by the respondents will not always be associated with taking action. An example of such a discrepancy can be observed in the attitude of some women towards mathematics. On the one hand, they perceive mathematical attainment as important, whilst on the other, they do not undertake education in this field (Gaspard et al., 2017).

The two theories discussed above differ in explaining what drives people to act and set specific goals. However, they strongly agree that individuals' decisions and goals result from combining "heart and reason" (i.e., rationality, emotion and attitudes) in fair proportions. This conclusion has important implications in the context of education. At school, boys and girls are regularly informed about the level of skills they have attained, are evaluated and tested in different ways. Good performance is a confidence-builder, but only to a certain level since high self-efficacy belief can compensate for certain deficiencies in knowledge. A sense of efficacy turns uncertainty into agency and helplessness into action, whilst individuals with the same level of performance may have a markedly different subjective perception of their own competencies (Beyer and Bowden, 1997). Both the sense of efficacy and the hierarchy of goals are constructs that are strongly embedded in interactions with the immediate environment, which results from the culture of the given environment and the stereotypes that function within it. The awareness of one's competencies is, therefore, of social origin. In this regard Eccles (1994) follow the previous generations of sociologists and psychologists, who argue that the environment in which an individual is raised shapes their goals in life and determines the conditions of their achievement.

The aforementioned concepts provide a framework for explaining the differences in educational decisions between men and women, taking into account factors other than school accomplishments. Both Bandura (1997) and Wigfield and Eccles (2002, 2020) maintain that achievements in a given field are influenced by what people think about themselves and what they consider important. On this basis, it seems reasonable to formulate the hypothesis that the educational decisions of boys and girls vary to some extent due to the different perceptions of their own competencies and a different degree of self-confidence. The existence of these differences may prove to be particularly important in the case of mathematics since many stereotypes and social beliefs are associated with the views on who can succeed in this field and in what circumstances.

7.2. Turning points in developing attitudes towards mathematics

Wigfield and Eccles (2002) note that the importance attributed by students to mathematics and their belief in their self-efficacy in the subject changes over the years. When starting formal education, students have an enthusiastic or at least neutral approach towards this subject. Once learning to count ceases to be fun and turns into a process involving higher cognitive functions, their attitudes to mathematics and their own skills become more critical. A weakening sense of mathematical effectiveness, i.e., a belief in low skills and a lack of belief in the possibility of success, may contribute to abandoning learning this subject.

Marcin Karpiński and Malgorzata Zambrowska (2015), who compared the changes in students' attitudes towards mathematics to a rolling snowball, drew similar conclusions. They noted that the development of unfavourable attitudes towards the subject becomes deeper at higher grades. The study found that students who suffered unpleasant experiences when they were exposed to mathematical tasks already at the early stage of school displayed a tendency to avoid this subject later. The process of deepening the dislike was partially inflicted by gaps in basic maths skills, without which more complex material could not be mastered. In the higher grades, these gaps accumulated, and the students' helplessness increased proportionally. Similar conclusions were reached by Anna Baczko-Dombi (2017), according to whom, attitudes towards mathematics are mainly formed in the first years of education and are fossilised in the following years. Failures, tensions, and frustration with mathematics lead students to look for other subjects (generally the humanities or social sciences) and to become convinced that they do not have a "mathematical brain". Growing discouragement usually leads them to seek other fields where they will have a sense of "being good at it". This is supported by a gradually adopted "anti-mathematics" identity and by being pigeonholed (both by themselves and their environment) as experts in other fields. Such self-definition rationalises their successive departure from mathematics and relieves them of the need to develop in this respect.

Thus, an early positive experience in mathematics may not stand the test of time at school. In a study of older students, Karpiński and Zambrowska (2015) found that students with negative attitudes toward maths were joined over the years by students who initially had a positive attitude towards the subject. To a certain extent, this was caused by the generally growing criticism of maturing students towards school and their higher tendency to question their own competencies. Other reasons may also lie in the increasing complexity of topics discussed in higher grades. Krzysztof Konarzewski and Krzysztof Bulkowski (2016) attribute the source of students' more negative approach to mathematics between the third and fourth grades of primary school to a change in the style of organising learning. Education in the early grades is less formalised and incorporates elements of play, whereas, after this stage, there is a rapid growth in expectations towards the students, a new teaching method is introduced, and a new teacher appears in class. Such changes may have a stronger impact on lower-ability students, who are entering a more demanding stage of education with gaps in their knowledge or insecurity. This may lead to frustration and induce negative emotional experiences, which strongly contributes to reinforcing their belief in their poor competencies. Due to the accumulation of lower skills and growing reluctance, they might transfer their interests to new subjects that appear in the curriculum in the higher grades and are unrelated to mathematics.

7.3. Third- and fourth-graders' attitudes to mathematics and reading

There are reasons to believe that girls and boys will differ in terms of how confident they feel in contact with a given field, how they assess their own skills and how well they cope with it compared to other subjects – thus, how confident they are in their math skills. Biographical and socialization experiences may contribute to these differences indicated in the previously discussed concepts of Bandura (1997) and Eccles (2002), as well as to the social belief in men's superior mathematical skills. Research shows that these opinions are shared even already by young children, who associate mathematics and complex intellectual tasks with boys more than with girls (Cvencek et al., 2011; Bian et al., 2017). It is not certain whether this is exactly the reason for the different mathematical self-confidence of Polish students of third and fourth grades, but the observation from other studies was confirmed at this level of, corroborating that girls rated their abilities lower than boys (Cvencek et al., 2011).

7.3.1. Self-perceived third graders' confidence in mathematics

In 2011, Polish third-graders were submitted in the Trends in Mathematics and Science Study (TIMSS), within which they were asked to assess their own mathematical skills, their attitude towards this subject, and mathematics classes (their understandability and clarity). The analyses (Annexe, Table A.8) suggest that girls in the third grade had a lower sense of mathematical competence than boys. Performance in the mathematics test strengthened the self--assessment of skills, which supports the conclusion that there is a positive relationship between attainment and a sense of ability. The inclusion of mathematics test scores decreased the gender gap in mathematics confidence, but the self-assessment of skills was still lower among girls. This means that while having the same results in mathematics tests, girls would rate themselves as poorer performers in the subject than boys. A difference was also observed in the strength of the relationship between test scores and the sense of competency between girls and boys. In the analyses, this was represented by the interaction of the two variables. Regardless of gender, high mathematical skills increased the level of the subjective assessment of these skills. However, among girls, the relationship was weaker than among boys, whose better performance in mathematics displayed a stronger correlation with mathematics confidence. It is notable that the difference in self-assessment of skills between boys and girls became wider among students with high scores. Introducing the factor of attitudes towards the subject into the analyses did not alter the results. It only implied that this factor was strongly associated with self-assessment of skills.

As noted previously self-assessment of mathematical skills influences motivation to learn mathematics (Bandura 1997, Wigfield and Eccles 2002). Controlling for the test scores, the confidence in mathematics skills among Polish third graders was lower among girls. Interestingly, no gender differences were observed in attitudes towards mathematics. This is also important because results in mathematics were less predictive of attitudes towards this subject than the perception of one's own skills (coefficient b for the "attitude towards mathematics" variable was 0.13(0.02) and 0.33(0.031) for "perception of skills"). The assessment of one's own skills differentiated girls and boys and had an even stronger impact on their achievements in the subject than their attitudes towards it. Similar differences in mathematical confidence of students in younger grades have also been reported in other studies (Ganley and Lubienski, 2016). These findings indicate consistently that women display greater mathematical uncertainty already at the early stage of education, and it continues after taking into account the results achieved in mathematics. The results regarding attitudes towards learning mathematics are less obvious and more difficult to verify. The relationship between attitudes and achievements is weaker than might be expected. This may result from the generally positive attitude of the third-grade participants of the 2011 TIMSS study. Polish students scored high in this respect compared to their peers from other countries surveyed in the same year, and higher than students with averagely higher skills (Konarzewski, 2012). This is exemplified by the students' responses that they enjoyed learning mathematics (67%) and that they liked the subject (69%), while only 13% of them agreed with the statement that "Mathematics is boring". It is possible that the positive attitude results from the teaching methods applied at this stage of learning, which does not yet place such demands on students as it does after completing early school education. Hence, negative associations with the subject had not yet had the opportunity to develop in this group of students.

7.3.2. Third-graders' attitudes towards reading

The development of attitudes towards mathematics and beliefs about one's own skills in this field can take place not only through interaction with the subject but also in comparison with other subjects at school. At an early stage, a point of reference for mathematics is linguistic education.

Polish third graders' attitude towards reading was strictly connected with gender. Boys were more often bored by this activity, enjoyed it less often, and reading was prompted as a compulsory activity imposed by the school rather than an intellectual need: 52% of boys and 32% of girls agreed with the statement that they reached for a book only when they had to, while 28% and 10%, respectively, agreed with the statement that reading was boring.

Boys and girls also differed in their assessment of reading confidence. This construct taps onto the perception of reading activity as easy and engaging and whether one deals well with more difficult texts. The analyses (Annexe, Table A.9) showed that girls had a clear advantage over boys. Taking into account the results of the reading comprehension test, the gender gap narrowed slightly but was still considerable. The relationship between self-assessment of competencies and the reading comprehension test scores was similar among girls and boys. Girls also scored significantly higher on the scale of attitudes to reading and motivation to read (Annexe, Tables A.10.1 and A.10.2). Both variables correlated with the scores of the reading test, albeit with different strength: the correlation with attitude towards reading was $r = 0.23(0.01)$, while that with motivation was $r = 0.06(0.02)$. All three variables were strongly associated with one another.

The picture that emerged from the attitudes of third-grade students was consistent enough to safely conclude that girls read willingly, voluntarily, and find pleasure in the activity. This practice, often daily, consisting of reading texts of various types and levels of complexity, undoubtedly translates into improved reading comprehension skills, which pays off at later stages of education (Manu et al., 2021).

A comparison of boys' and girls' attitudes towards mathematics and reading in the third grade reveals a distinctive pattern. Girls complete the early education stage with less positive confidence in their own mathematical skills than boys. At the same time, it cannot be said that their attitude towards this field and to learning is negative. It is likely that in their own perception mathematics is not an area in which they feel strong. In contrast, they feel the opposite towards reading books. Will this asymmetry change or persist in the future as they are confronted with more advanced material in the core curriculum?

7.3.3. Self-perceived fourth graders' confidence in mathematics

Primary school children in grades three and four are only a year apart, but they are in different educational environments. Completing the stage of integrated education involves a transition to a more advanced education. Unlike the model applicable in early education, fourth-grade students are assessed by several teachers, not one, and progress in knowledge is expressed on a numerical scale, i.e., using grades. At the same time, expectations towards students grow, both in terms of independent organisation of learning and the acquisition of larger and more complex amounts of information.

Girls in fourth grade assessed their mathematical potential lower than boys. Similarly to the case within younger students, gender significantly differentiated the assessment of one's own competences, and taking into account actual mathematical skills reduced this difference, but did not eliminate it (Annex, table A.11). This indicates that girls were, on average, less confident in their own abilities for similar test scores.

Mathematical achievements were correlated with the subjective assessment of one's own competences, but this relationship was weaker among girls. Importantly, the difference in the assessment of skills between the genders also increased in the group of students with high scores – the better the achievements, the greater the gap in the assessment of one's own skills (to the benefit of the boys).

Thus, in 2019, girls in the fourth grade were less likely to say that they were good at the subject, were able to solve assignments and were quick learners. However, as far as generalised attitudes towards the subject were concerned, gender differences were negligible. Almost identical share of girls (74%) and boys (75%) reported that they liked mathematics, and almost as many suggested that they liked solving mathematical problems: 51% of girls and 59% of boys agreed with the statement "Mathematics is one of my favourite subjects". This may imply that although girls like the subject, or at least do not have a negative attitude towards it, they separate this attitude from the assessment of their own competencies. In other words, girls like mathematics as much as boys do, only they do not feel as competent in the subject.

7.3.4. Fourth-graders' attitude to reading

In 2016, fourth-grade students were asked in the PIRLS to describe their own reading confidence and attitudes towards reading. The analysis of the Polish sample (Annexe, Table A.12) showed that girls in the fourth grade had greater self-confidence than boys, but this advantage disappeared when achievements in reading tests were considered. Equal scores in reading tests meant that the difference in self-assessment of competencies disappeared (in the third grade, girls still rated their competencies higher, even after taking this factor into account). This suggests that girls and boys with similar reading comprehension skills had a similar level of reading confidence, which was not found case of mathematics. Similarly to third-grade students, as their skills improved, confidence in their reading competencies increased to a similar extent in both boys and girls.

Differences between boys and girls were observed also in other dimensions of their attitude towards reading. Girls scored higher in terms of engagement in reading lessons and enjoyment of reading (Annexe, Tables A.13.1 and A.13.2). Smaller gaps between the genders were observed within the second aforementioned issue. It should be noted, however, that the scale reflected the manner of participation in class and the rating of understandability of the communicated material to a greater extent than a personal fondness of reading. There were no big differences between girls and boys in the level of understanding of the content presented by the teacher and his or her expectations as well as in the scope of interest in the topics taught during classes.

The opinions and attitudes of fourth-grade students revealed the same pattern for both genders as observed in the tests for lower-grade students. On average, girls gave a better rating to Polish classes and had a positive attitude to reading: 83% agreed with the statement "I enjoy reading" (68% boys), 17% of girls and 31% of boys found it boring, and 76% and 57%, respectively, declared that they would be happy if someone gave them a book as a present. Finally, 63% of girls and 46% of boys would like to have more time for reading.

Comparative analyses between the 2011 and 2016 rounds of PIRLS showed that the attitudes of fourth-grade students to reading and classes involving this skill were more negative than that of third-graders, although there was an increase in their self-assessment of competencies in this field (Konarzewski and Bulkowski, 2016). At the same time, the improvement in the level of their perception of their own competencies was greater than the actual increase in their reading skills compared between the two study rounds. This may suggest that the relation between the objective test scores and the subjective perception of one's own competencies became looser among higher grades.

Girls in the third and fourth grades showed higher self-assessment of reading skills, although in older grades this advantage diminished after taking test performance into account. Additional analyses have suggested that in the fourth grade, girls and boys with a similar level of reading skills also demonstrated higher self-assessment in particular sections of the score distribution. This was a different pattern than that observed in fourth-grade students' mathematical competencies, where girls rated their confidence level as lower, also after considering the mathematics test results, and the difference increased in the group of students with high results. In other words, the difference in the level of reading assessment between boys and girls was largely due to differences in skills in this area, albeit the same cannot be said about self-confidence in mathematics. This pattern may suggest that factors other than skills in a given field may have a stronger impact on the assessment of one's own mathematics competencies than on that of reading skills.

Gender differences in reading confidence can be interpreted in various ways. It is likely that girls are more cautious in assessing their own competencies and that their opinions depend more on actual performance. Research suggests that they cope worse than boys with a vision of failure and the resulting criticism from others (Borgonovi and Han, 2021). This insecurity may be apparent in skills that are usually associated with women (e.g., verbal skills), where they are expected to have high competencies. It is possible that girls are cautious in their self-assessment because they are trying to avoid possible criticism if they do not conform to the image of a "linguistically talented student". Another explanation may be that men tend to be overly optimistic about their own skills in comparison to their actual competencies (Lee and Stankov, 2018). This might suggest that it is not girls who underestimate their competencies, but rather that boys are overly optimistic about their skills (Cho, 2017; Van Veldhuizen, 2017). Both genders may be inaccurate in their subjective assessment of their skills, but the trend of these errors may be different for men (overestimation) and women (underestimation). This factor may be relevant for school decisions since girls consistently rate their mathematical potential lower than boys and their verbal skills at a similar level.

7.4. 15-year-olds' self-perception of mathematics and reading skills

The attitudes of girls and boys towards mathematics differ already at the first stage of education. At upper educational levels, these orientations may or may not continue, since attitudes towards particular subjects are influenced by a variety of factors which had not emerged before. Aspects related to socialisation include, for instance, teachers and significant others (Evans and Field, 2020), as well as peers (Moliner and Alegre, 2020), who in the process of social interactions can swing the pendulum of interests in the opposite direction. The impact of these individuals is especially important when students make key educational choices regarding subjects taught at advanced level, specialisations, and subjects in which secondary school leaving examinations are taken, which determine their future. In the higher grades, attitudes towards a given field, beliefs about one's own skills, individual preferences, anxieties, and uncertainty about the future may come into play.

15-year-old students from Poland were at this educational stage when they took part in the PISA in 2012. The analysis showed that girls rated their mathematical competencies lower than boys (Annexe, Table A.14). When the mathematics test scores were considered, the difference declined, but was still significant, showing that the trend observed in the lower grades persisted. It is also worth noting that high scores in mathematics tests translated into higher ratings of self-assessed competencies.

The interaction between gender and mathematical skills showed that the relationship between the perception of one's own competencies and the results obtained in the mathematics test looked slightly differently for the two genders. As test scores increased, girls' perception of their competencies increased more than that of boys. The opposite difference between the genders occurred in the group with the lowest scores in mathematics tests: girls rated their own competencies lower than boys with the same average achievements. Instrumental motivation for mathematics had a similar effect. Among students with poorer test scores, the difference in perceived mathematical competencies between the genders was relatively large and lower among girls. Nonetheless, the gender gap narrowed as skill levels increased. These patterns may suggest that only girls with higher skills or career plans that include mathematics have a sense of confidence in mathematical competencies that is similar to that of boys. Boys, however, even those with lower test scores and who are not planning mathematics-related careers, have significantly more confidence about the subject. Differences in self-assessment of competences decreased after including variables expressing an instrumental attitude towards mathematics and school and career plans related to this field in the analyses.

Similar conclusions, albeit in relation to differently measured subjectively perceived mathematical competencies, were also obtained in other surveys. For example, Dorota Turska showed that among the poorest-performing students, girls rated their skills considerably lower than boys. In comparisons of the highest achievements, the gender difference was smaller, but girls were still less confident in their efficacy (Turska, 2013).

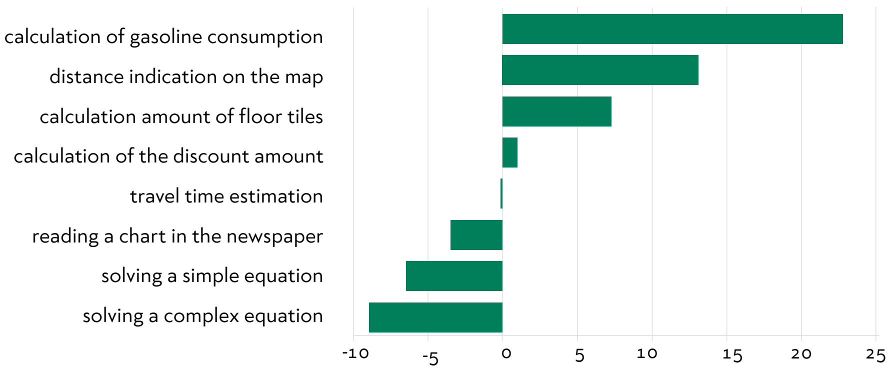
In the sample of Polish 15-year-old students, the differences in self-assessment of mathematical competencies narrowed when instrumental attitudes towards mathematics as well as school and career plans were taken into account. There were no statistically significant differences by gender in the group of students with a pragmatic approach to the subject. However, the differences between genders appeared in reference to educational and professional plans. The 15-year-old participants of the PISA 2012 study were asked to choose one of two statements about their educational and career plans, of which one statement was related to mathematics and the other to Polish or science (Annexe, Table A.15). Girls were less likely to link their educational and professional plans with mathematics, regardless of whether the alternative was science or Polish. In each scenario, the choice of a mathematics-related career path was more probable for men. Boys had more than twice as many chances to choose an option that indicated their willingness to study mathematics and work in a mathematics-related profession. They also had twice as many chances to choose an option related to mathematics when this field was put next to intensive learning of Polish.

The PISA 2012 focused on the attitudes of boys and girls facing a stage that was a synthesis of their previous school experience on the one hand, and that would affect their future educational and professional life on the other. Based on the responses, we cannot say whether the intentions of the boys and girls will materialise, but the observed differences by gender coincide with the structure of students enrolled on degree programmes in mathematics.

The above-discussed scales of subjective assessment of one's own mathematical skills and attitude to the subject were referred to the school context. Beyond this, it is possible to observe further differences between boys and girls. 15-year-old students who took part in PISA in 2012 assessed the extent to which they would cope with specific problems requiring mathematics competencies. Some of the statements referred to school activities or assignments, while others concerned the application of mathematics skills in practice (using a train timetable to estimate travel time from one place to another; determining how much cheaper a television set sold at a 30% discount would be; calculating how many square metres of floor tiles would be needed to cover a floor; understanding figures in newspapers; solving an equation, e.g. $3x + 5 = 17$; determining the exact distance on a map on a scale of 1:10000; and calculating the fuel consumption of a car (*PISA 2012: Technical Report*). The participants of the study responded using a four-point scale to express their self-confidence towards a given mathematical problem. Figure 7.1 shows the difference between boys and girls who were "confident" or "very confident" that they could handle a given task (bars to the left from zero indicate that a larger percentage of girls than boys could cope with a given task, and on the right that boys scored better).

A comparison of different scenarios shows that the beliefs of boys and girls about their competencies depended on the context. The smallest differences between genders were observed in the problems concerning the calculation of a discount and the estimation of travel time by train based on a timetable. Larger discrepancies in favour of boys emerged when the students were asked to calculate a floor area to be tiled, to determine distance using a map, and to estimate the amount of fuel required.

FIGURE 7.1. DECLARED SELF-CONFIDENCE OF BOYS AND GIRLS CONCERNING SELECTED MATHEMATICS PROBLEMS (N = 4607)*



Source: PISA 2012.

* The bars indicate the difference in p.p. between boys and girls who responded that they felt "confident" and "very confident". Values above zero show that more men than women declared that they would cope with a given problem, whereas values below zero point to the advantage for women.

Other studies have also shown that women's confidence in their own mathematical competencies is constrained by context. Analyses conducted by Sylvia Beyer and Edward M. Bowden (1997) suggested that they were more likely to question the correctness of their solutions to problems if the content related to stereotypically masculine activities. They displayed greater self-confidence than men when mathematics problems appeared in a neutral context and required the use of similar skills. It can be assumed that Figure 7.1 reflects, to some degree, a pattern showing that mathematical confidence depends, to some extent, on the context in which a problem occurs. Although the PISA participants possessed the appropriate skills to calculate fuel consumption or estimate the number of floor tiles, girls felt less confident in these areas. Boys perceived themselves as more competent in this respect but lost some confidence with regard to mathematical problems at school. These differences may imply that stimuli related to stereotypes may strengthen or weaken the sense of competency in a given area and, perhaps, the actual effectiveness in solving problems.

Similarly to the lower grades, girls, on average, rated their reading skills higher than boys (Annexe, Table A.16). The relationship between the scores in reading tests and the skill assessment was positive among all students, albeit slightly stronger among girls. This means that girl's self-confidence in their reading competencies grew as their skills increased to a greater extent than that of boys. This is a different pattern than the ones observed earlier in mathematics, where the difference in mathematical self-confidence was much higher for boys among students with low mathematics test scores. In this case, gender differences regarding subjectively perceived reading competencies among students with low reading test scores were small, but widened as the level of skills increased, to the advantage of girls. However, these results are not comparable to those of previous school years due to the different operationalisation of the concept of reading competency.

7.5. Mathematics anxiety and educational decisions

Mathematics holds a special place among school subjects. It is valued for the role it plays in economic and social development, but also for its usefulness in everyday life. Having mathematics skills is sometimes identified with high intelligence. In common understanding, it is associated with the specific construct of the "scientific mind". At the same time, school mathematics clearly links the affective with the cognitive dimension to a greater extent than other disciplines. The range of emotions caused by dealing with numbers is particularly wide; from anxiety or fear to a sense of experiencing beauty, enthusiasm, and excitement. Researchers in the field of education are especially interested in the spectrum of more difficult emotions that emerge during actual or even imagined interaction with mathematics. This focus is well-founded. It can be assumed that anxiety, fear, tension and stress have a negative influence on the effectiveness of solving problems and, in the long run, can consolidate negative attitudes towards the subject. Over time, these factors may lead to decisions to withdraw from mathematics. In this section, I will look at the issue, considering the differences in the attitudes of women and men.

Mathematical anxiety is a state of tension or discomfort when dealing with mathematics. It can affect students' performance at school in different ways. The most immediate effect is a decline in performance in mathematics tests. The relationship between anxiety and lower performance has been confirmed in studies and meta-analyses conducted on multiple samples of students using a range of measurements (Ma, 1999; Hawrot and Kaczan, 2014; Zhang et al., 2019). The general conclusion from these studies is that people who experience mathematics anxiety are less likely to give correct answers in tests, more likely to make errors, and tend to leave out questions they find more difficult.

One of the reasons for the reduced effectiveness in solving problems is the impaired function of the working memory caused by an anxiety stimulus. Błażej Szymura, Agnieszka Waluszko, and Dariusz Stachów (2003) demonstrated that people with a neurotic (anxious) personality made limited use of their working memory resources, which store and process information. The researchers observed that the minds of anxious people are simultaneously preoccupied with two processes. When they attempt to solve a problem, they focus some of their intellectual energy on suppressing (quietening, subduing) intrusive thoughts associated with anticipated failure. By worrying about the outcome, such people turn their attention away from the problem to a series of unproductive deliberations about the result, which is probably the main reason for their lower performance. Worrying triggers an avalanche of imagined negative consequences of one's actions, leading to a permanent anxious response (Cassady and Johnson, 2002). Instead of focusing on creative and effective reasoning that could lead to achieving a goal, people who experience anxiety begin to question their own competencies or think about the unpleasantness they will suffer from others in their surroundings. The researchers emphasise that worrying is particularly detrimental to people with high levels of anxiety who have to deal with a more complex problem or those whose anxiety is intensified by an additional stressor (e.g., time pressure). This is so because problems that are cognitively more difficult, in addition to stressful situations, make it necessary to activate the whole working memory, including the subsystem responsible for storing the visual and spatial material needed to solve mathematical problems. If the challenges are easier or there are no additional anxiety stimuli, performance can be improved by engaging part of the working memory that is not preoccupied with processing intrusive thoughts (Miller and Bischels, 2004; Orzechowski et al., 2009).

However, researchers do not always agree on which element in the relationship between mathematics performance and anxiety is the cause and which is the effect. Both hypotheses, that is, "low mathematics skills are the reason for unpleasant feelings" and "anxiety leads to lower skills" are reasonable. For example, Elizabeth A. Gunderson et al. (2018) demonstrated that children with low skills at the beginning of school were more susceptible to developing mathematics anxiety, which reinforced reluctant attitudes towards the subject at later stages of education. Experiencing negative emotions motivates individuals to undertake actions to eliminate the source of unpleasantness. Hence, children with a high degree of anxiety develop responses that protect the Self from experiencing failure and negative thoughts about themselves (Gruszczyk-Kolczyńska, 2006). In younger students, the repertoire of these strategies includes actions aimed at postponing (if only for a moment) interaction with a problem as well as more complex cognitive mechanisms. For example, children with difficulties in mathematics tend to mentally wander off from a problem, which at the behavioural level manifests as looking around the room, focusing attention on background features and excessive motor stimulation (Gruszczyk-Kolczyńska, 2006). Chronic anxiety contributes to lower self-confidence and increased failure anxiety. It also forms the basis for building a belief in one's own lack of competencies (Zeidner, 1998; Katzelnick and Greist, 2001). Carol S. Dweck and Ellen L. Leggett (1988) also noticed that children who demonstrate helplessness towards problems tend to situate the source of their failure within themselves and are more likely to associate it with their own intellectual or personality limitations, that is, their permanent traits. Such students tend to negatively self-assess and are less likely to look for reasons for their failure in external factors.

7.6. Mathematics anxiety and gender

Research consistently shows that mathematics anxiety is related to poor performance in mathematics (Miller and Bichsel, 2004). Do we have any reason to believe that this relationship is stronger in women and that the anxiety factor is connected with their withdrawal from the subject? Analyses show that women are more likely to feel mathematics anxiety than men. In the PISA 2012 study, girls from nearly all the OECD and associated countries declared a higher level of mathematics anxiety than boys (*PISA 2012: Technical Report*). A similar pattern in various school contexts could also be observed among Polish students.

Girls expressed concern more often than boys that the demands in the classroom would be too much for them (60.9% and 53.7%, respectively). They also worried that they would get poor grades and felt helpless. Boys were more likely to mention discomfort in the context of doing homework. There were no significant differences between the genders regarding anxiety when solving mathematical problems.

TABLE 7.1. PERCENTAGE OF 15-YEAR-OLDS EXPERIENCING MATHEMATICS ANXIETY IN VARIOUS CONTEXTS (PISA 2012, N = 3024)*

Statements addressed by the participants	Girls	Boys
I often worry that it will be difficult for me in mathematics classes.*	60.9%	53.7%
I get very tense when I have to do mathematics homework.*	26.9%	32.1%
I get very nervous doing mathematics problems.	31.6%	30.8%
I feel helpless when doing a mathematics problem.*	34.2%	27.7%
I worry that I will get poor grades in mathematics.*	64.8%	56.4%

Source: PISA 2012.

* $p < 0.05$. Percentage of participants who chose "Agree" or "Strongly agree" in response to a particular statement.

A clue that can help understand the differences are the patterns reported in the general population. These suggest that women are more likely to experience symptoms of anxiety-related and depressive disorders, including panic disorder, obsessive-compulsive disorder, anxiety disorder, post-traumatic stress disorder, and social phobias (Asher et al., 2017). Other research shows that anxiety may cause different reactions in both genders. Some analyses also demonstrate that men respond to stressful school situations in a similar way to people with low levels of examination anxiety. They display a higher level of stimulation which manifests as enthusiasm more often than fear or lower confidence in their own competencies (Zeidner, 1998). These general personality predispositions may constitute the basis for the development (or lack) of mathematics anxiety.

Another reason for the differences in this area may be mathematics skills. Lower skills will most likely increase fear of mathematics, although it is difficult to predict whether the path of this relationship is different in women and men. These uncertainties are explained in part by the findings of the analyses (Annexe, Table A.17). Girls reported a higher level of mathematical anxiety, however, the better the mathematics test score, the lower the fear of this subject. When this factor was considered, the difference in the level of anxiety between genders diminished. Among students of both genders, the association between test scores and anxiety was negative and only slightly higher among girls. Moreover, the better the mathematics test scores were, the lower the anxiety towards the subject. This factor is probably more important than gender in shaping anxiety attitudes towards mathematics.

Putting the issue of differences between boys and girls aside, it is worth looking at the scope of the mathematics anxiety in Poland. In 2012, more than half of the students in the last grade of lower secondary schools worried about getting poor grades. About one-third felt helpless when faced with mathematics problems and were nervous when solving them, while 57% were afraid that classes in this subject would be difficult for them. The widely experienced fears may partially explain the not-so-positive image of this subject in the eyes of students, who believe that mathematics is difficult, that it requires a lot of systematic work, and that the knowledge acquired during classes will not be useful in their adult life. The consolidation of negative emotional responses may contribute to avoiding mathematics. Research on this phenomenon demonstrates that this subject, like no other, is mythologised on various levels (Baczko-Dombi, 2017). One of the dimensions of this phenomenon is the common belief that mastering mathematics requires an innate talent that only the "scientifically-minded" possess.

Even if some gender differences exist in the levels of mathematics anxiety, this does not mean that it makes a different impact on the scores of boys and girls. The existing research is not conclusive. Some studies suggest that mathematics anxiety causes a negative impact only on the scores of girls (Devine et al., 2012; Hill et al., 2016; van Mier et al., 2019). Others show an opposite effect (Hembree, 1990; Wu et al., 2012). In turn, meta-analyses that synthesise the outcomes of many studies argue that mathematics anxiety has an equally negative effect on the scores of both boys and girls (Zhang et al., 2019). Considering the complicated issue of the impact of anxiety as well as its source and differences in intensity, the discrepancies in the results of such studies are not surprising. Establishing the relationship between anxiety and achievements may also be hampered by a variety of cognitive strategies which students use to cope with unpleasant feelings. Edyta Gruszczyk-Kolczyńska (2006) emphasises that the responses of students to difficulties in mathematics are related to their level of self-control. People who can regulate their emotions, who are able to control their anxiety, and who demonstrate high emotional resilience are generally better at coping with challenging situations. The remedy for anxiety is "mathematical resilience", which Sue Johnston-Wilder and Clare Lee (2008) defined as the ability to overcome affective setbacks that obstruct learning. Students who use such strategies will actively look for solutions to the difficulties they experience, make further efforts to solve mathematics problems, and will not be discouraged by failure.

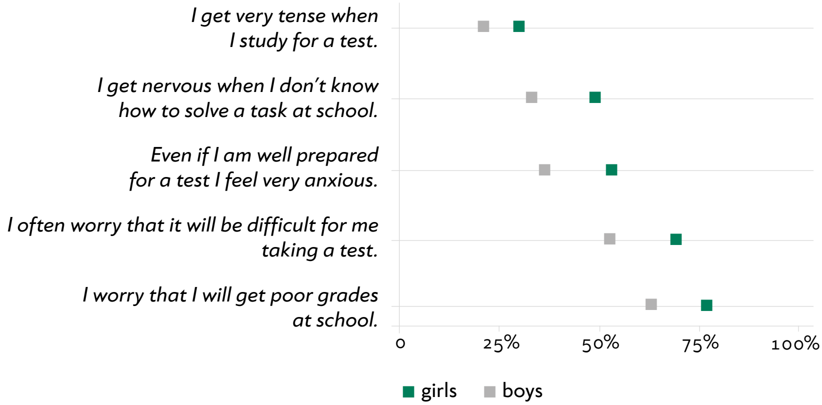
The PISA 2012 findings support the hypothesis that mathematics anxiety affects the results of boys and girls to a similar degree. On average, girls reported greater anxiety, but only until the mathematics test scores were considered. Although higher levels of anxiety had a negative impact on the scores in general, there is no strong reason to believe that this relationship was expressed differently in boys and girls. Based on self-reporting, research on the subjective assessment of mathematics anxiety involves students describing their emotions in specific imaginary situations, for example, during tests in mathematics, when solving problems, and during classes. Nevertheless, it is possible that the results would be different, of this issue was tested with other means of measuring mathematics anxiety.

7.6.1. Test anxiety and gender

Mathematics anxiety may not be the only source of unpleasant feelings at school. A related phenomenon that can cause emotional discomfort is the fear of being tested. In psychology, it is most often associated with test anxiety, which is a state of increased anxiety that appears when skills are subject to actual or imagined assessment. It manifests in a range of physiological responses, including accelerated heartbeat, excessive sweating, and dizziness.

Similar to mathematics anxiety, test anxiety affects both genders in a different way. This is indicated by the responses of 15-year-olds in the PISA 2015 study who reported their emotions regarding knowledge assessment in various contexts. The data in Figure 7.2 shows that unpleasant feelings associated with selected aspects of everyday life at school were more apparent among girls. Girls worried more often about poor performance (even when they were confident in their high competencies), and the prospect of failure made them tense. Boys were less anxious when solving problems and were less worried when they were unprepared for a test.

FIGURE 7.2. SYMPTOMS AND INTENSITY OF TEST ANXIETY AMONG STUDENTS PARTICIPATING IN PISA 2015 (N = 4478)*



Source: PISA 2015.

* Percentage of girls and boys who responded "Agree" and "Strongly agree" to a particular statement. The differences between genders in each statement are statistically significant at the level of $p < 0.05$.

Additional analyses (Annexe, Table A.18) suggest that this difference persisted when taking into account mathematics and reading tests as well as the students' achievement orientation. This last factor reflects the student's level of ambition and their desire to achieve high results at school. Test scores in both areas were negatively related to test anxiety, implying that this may be at least partly explained by the student's performance: an increase in scores on both tests lowered anxiety. It seems like student's high skills alleviated the unpleasant feelings that appear when coping with a stressful situation. An increase in test scores was associated with a decrease in test anxiety among boys and girls to a similar extent, albeit the decrease was slighter among girls. Among students with better reading performance, boys had a lower level of test anxiety than girls. The pattern was similar in mathematics, although on average, the gender gap among students with higher scores was smaller.

A factor that increased anxiety levels was orientation at achievement. In the case of both girls and boys, an increase in motivation for achievement was also tantamount to an increase in school tension. The negative effect of this stimulus persisted after considering factors that alleviated the student's anxiety as well as good test performance. This relationship confirms the common opinion that the pressure for results and achievements and comparing oneself in this context with others at school are combined with experiencing higher anxiety.

7.6.2. Failure anxiety

Another frequent source of school anxiety is exam situations. Andrew J. Elliot and Todd M. Thrash (2004) pointed out that people with failure anxiety organised their thoughts in a characteristic way that was usually detrimental to themselves. Failure anxiety works outside the system of rational thinking and directs an individual to behaviours that lead to potential failure. This includes focusing on and assigning great importance to information that is consistent with their pessimistic vision. This type of anxiety features a social dimension. It is fuelled not only by the prospect of failure but primarily by a fear of how the environment will respond to it. Highly anxious people are afraid of shame and judgment from a real or imagined audience more than their own lack of success. The environment's unrealistic expectations regarding the ideal self as well as individual predispositions (e.g., a generally higher tendency to experience difficult emotions) may contribute to intensifying fears. People who are prone to neuroses are more responsive to factors that trigger a sense of shame due to their generally higher sensitivity to emotional stimuli. Nevertheless, the response to stressful situations is not the same among such students. On the one hand, anticipated failure may lead them to adopt a passive attitude to avoid unpleasant emotions, and on the other, it may increase their motivation to work harder in order to avoid failure. Hence, it is not a foregone conclusion that failure anxiety will always have a negative effect on test performance.

Failure anxiety is a phenomenon whose intensity is affected by cultural, social, and economic factors. However, as far as gender is concerned, the pattern is relatively consistent. The international PISA study in 2018 demonstrated that in 56 out of 59 countries, a higher level of failure anxiety was recorded in women (Borgonovi and Han, 2021), including young women from Poland.

TABLE 7.2. TYPES OF FAILURE ANXIETY IN STUDENTS PARTICIPATING IN PISA 2018 (N = 5652)*

When I am failing...	Boys	Girls
...I worry about what others think of me.	47.1%	59.7%
...I am afraid that I might not have enough talent.	48.4%	65.6%
...this makes me doubt my plans for the future.	48.6%	68.1%

Source: PISA 2018.

* $p < 0.05$. Students were asked to respond to the statements quoted in the table (sum of "Agree" and "Strongly agree" responses).

Failure anxiety was common among Polish adolescents, but this type of emotion concerned mostly girls, who, more often than boys, regarded failure as an indicator of their own abilities and declared that failure could be a reason to change their educational and professional plans. Girls were also more concerned about the opinion of others, due to, as one might guess, their anticipated feeling of shame and embarrassment.

Among Polish 15-year-old PISA participants (both genders), poorer scores in mathematics and reading tests were associated with increased failure anxiety (Annexe, Table A.19). On average, anxiety levels were higher in girls also when performance levels in both fields were considered. The effect of reading test scores on failure anxiety was different from that of the mathematics tests. The level of failure anxiety between boys and girls was similar (and lower on average) among students with poor scores, but the gap between genders widened in the group with better test scores, which means girls suffered greater failure anxiety than boys. This is a rather surprising observation if one considers the superiority of girls in reading skills. Previous analyses, however, suggest that they rated their skills higher than boys provided that test scores were not considered. Girls' greater failure anxiety may, therefore, be explained by other factors than reading performance, for example, their greater sensitivity to criticism.

One explanation of the average higher failure anxiety among girls may include different styles of parenting of boys and girls, and more specifically, different gender-specific tolerance of a child's mistakes and failures. This was noted, among others, by Steven M. Alessandri and Michael Lewis (1993) who observed parent-child dyads during simple cognitive and dexterity games. Their analysis of responses suggested that in a group of children who performed equally well on a given task, boys were more likely to be praised, while girls experienced more critical communication. Alessandri and Michael's research and other studies also suggest that girls are more likely to respond with shame in a situation that they would define as failure (Alessandri and Lewis, 1993; Pivetti et al., 2016). Parents' response patterns to their children's failures differ, but what is equally important is that the emotional responses of girls and boys are not the same, with that of the former more frequently manifesting in shame. It cannot be ruled out that on the basis of simple conditioning, the unpleasantness caused by this feeling discourages women from undertaking actions that may be subject to public assessment.

Moreover, the presence of gender differences in self-reporting questions on anxiety and worrying may be influenced by the way people process and understand their own emotions. It is not unlikely that the reported higher level of worrying in women is to some extent the effect of the widespread acceptance of their articulation of difficult emotions. Social behavioural norms impose greater restrictions on men's expression of emotions, especially those that contradict their positive image of having confidence and courage. Fear, anxiety, worrying, and insecurity are states that society tends to associate with women, and they do not fit the stereotypical image of men. It is possible that the students' reports of mathematical and test anxiety as well as their failure anxiety reflect, to some extent, the level of boys' self-censorship in situations when they should express emotions.

7.6.3. Stereotype threat

The phenomenon of stereotype threat may help explain the differences between women and men in experiencing fear and uncertainty about their own competencies. Stereotype threat was first observed in research on the academic achievements of Black and White students at American universities. The manipulation involved telling African American students that the test they were about to take was intended to assess their intellectual potential. Subsequently, the students scored lower than their white colleagues in the comparison group. However, this difference disappeared when the respondents were informed that the purpose of the test was only to solve problems (Steele and Aronson, 1995). The most important conclusions, however, were formulated after another stimulus was introduced, namely a declaration of racial affiliation. When Black students were asked to fill in information about this on the survey form, they performed worse again when compared to White students. The reason, of course, was not a sudden decline in their skills. Claude M. Steele and Joshua Aronson (1995) explained that the differences in the outcomes were influenced by the activation (through declaration) of the stereotype regarding the lower intellectual abilities of people with dark skin. Further research also showed that the activation of this social cliché made people question their own competencies and affected their perception of the test, whereby students of colour assessed the test as more difficult and were, therefore, more unsure of their skills.

Later analyses led to the conclusion that stereotype threat reduces efficacy when performing tasks that refer to this cliché, regardless of the context. Jeff Stone (2002), for example, demonstrated that Black amateur athletes performed worse compared to Whites when they were told that they were competing in "athletic intelligence" rather than just for scoring points. White people performed worse when they were told that the same competition tested their innate athletic talent. The activation of a stereotype may also have lowered White students' mathematics performance in comparison to those of Asian descent when the "smart Asian" stereotype was activated prior to taking a test (Aronson et al., 1999).

The negative impact of stereotypes on performance in this field has been confirmed in recent meta-analyses (Nguyen and Ryan, 2008). However, some researchers question the unanimity of these findings, claiming that they have been discussed in fewer published studies and that this fact has led to different conclusions. Paulette C. Flore, Joris Mulder, and Jelte M. Wicherts (2018) suggest that studies which prove the impact of stereotyping on women's worse mathematical performance are more likely to be published than those which do not confirm this outcome. Consequently, conclusions may be selective and distort the actual phenomenon.

Activating a stereotype involves triggering specific beliefs in the minds of respondents. Such content is related to social hierarchies, divisions, and inequalities linked with certain characteristics, including race and gender. This leads to triggering specific defensive responses in individuals, similar to those that appear in situations which elicite anxiety. People try not to accept negative opinions about themselves easily (e.g., that their race or gender influences how they perform in a given field) and take action to contradict the stereotypical opinion. Sylwia Bedyńska and Piotr Rycielski (2016) suggested that people initially motivate themselves to deny the behaviours predicted by a stereotype, but this energy wears off quickly. They experience cognitive exhaustion and are unable to effectively use strategies for denying social clichés. Subsequently, they may feel helpless, avoid effort, and redirect their attention to an area that does not require them to make additional attempts at denying stereotypes.

Fear of stereotyping and mathematics anxiety probably have their sources in a similar cognitive mechanism. In both cases, negative thoughts, worrying and predicting the potential reaction of the social environment to failure consume the working memory that is necessary to properly complete an assignment. In this situation, cognitive resources are dedicated to activating mechanisms that lead to the suppression and denial of negative thoughts. This may lead to, for instance, greater caution in performing tests and, in other situations, using self-handicapping strategies for postponing the fulfilment of a task. A form of defence against such situations may be to lower the expectations regarding one's own performance to the level represented by the group to which the stereotype applies. Consequently, this may also lead to lowering individual results.

7.6.4. Does stereotype threat discourage women from mathematics?

Stereotype threat is another clue to understanding the differences in the attitudes of boys and girls towards mathematics. With a widespread social belief that women perform worse in this field, the activation of the stereotype should have a negative impact on their results. One of the first studies to show the effect of stereotype manipulation on lowering girls' performance regardless of skills was an experiment conducted by Steven Spencer, Claude Steele, and Diane Quinn (1999). One group of respondents was told that men had performed better on a previous edition of a test, and the other that women and men had done equally well. The difference between the genders occurred only in the first case, where manipulation was involved.

Subsequent research, however, did not confirm this hypothesis. Studies on large samples and meta-analyses using advanced statistical methods suggested that stereotype activation had no or negligible effect on explaining the differences in mathematical performance between girls and boys (Flore et al., 2018; Agnoli et al., 2021). Other analyses also demonstrate that performance did not decline after activating stereotypes, contrary to what was predicted by the concept of the social cliché threat (Stoevenbelt et al., 2022). An explanation of the differences in the findings of more recent and older studies on the impact of stereotype activation may lie in the changing methodology, which uses, among others, the priming effect to a greater extent.

On the other hand, some researchers have argued that the negative impact of stereotyping on women's mathematical performance may depend on the degree of their identification with the field. Contrary to intuitive predictions, a high degree of identification may lead to lower efficacy. Questioning the mathematical skills of women who held the field in high regard shook their confidence in their self-efficacy to a greater extent than that of women in a comparison group who were given either neutral ("There are no differences between genders") or positive ("Women do better") messages (Cadinu et al., 2003). It is possible that women who identify more strongly with mathematics feel a greater need to contradict popular stereotypes which, in turn, leads to their poorer performance. Furthermore, Toni Schmader (2002) demonstrated that women who considered their gender an important component of their self-definition scored lower in solving mathematics problems compared to men. However, this difference did not appear among women for whom gender affiliation was not as important. As suggested by research, the poorer performance of women with high gender identity may be caused by their desire to maintain consistency between their performance and the dominant stereotype. If such an assumption were true, it would mean that the fields of engineering and mathematics attract those women whose sense of identification with stereotypical femininity is somewhat looser.

7.7. Summary

Men and women have different concepts of their own capabilities at different levels of education. Women, both younger and older, are more critical of their own mathematical competencies than men. Differences in assessment were apparent among boys and girls in grades three and four and among 15-year-olds. At these stages of education, boys demonstrated better self-assessment of their competencies, and this advantage also persisted after considering their actual level of skills. In older students, the difference between genders also persisted after taking into account test scores, but also career plans that involve mathematical knowledge.

Reading confidence is not a simple reversal of the mathematics pattern. Indeed, girls generally assessed their skills better than boys; however, among fourth-graders, this difference diminished after considering their reading comprehension skills. Among younger students with similar competencies, boys and girls rated their reading skills similarly, but the situation changed among 15-year-olds. Girls showed higher reading confidence than boys as the difficulty of language tests increased. It is possible that older girls, based on the results acquired over several years of education and experience, had become more self-confident compared to younger ones. A high level of confidence in one's own reading competencies among 15-year-old girls may be an important factor in choosing their next level of education.

It is difficult to judge which gender has a more distorted image of their skills, but differences in this area put boys and girls on slightly different educational paths. In the longer term, this may (and usually does) lead to different professional careers. Some boys prefer domains that minimise the need to read extensive texts, verbalise their own experiences and those of fictional characters or reconstruct the motivations of such characters. Even if they rate their reading competencies relatively high, they are more likely to regard such activities as an imposed task. Mathematics relieves them from the need to create elaborate verbal descriptions, interpret emotional states, understand literary protagonists, and interpret complex social situations. It is likely that men are more willing to take exams in mathematics and choose related fields of study not because they have a particular penchant for this field but because they are weaker at using words and processing texts. The reluctance to read and poorer language skills may be why men do not actually "pursue mathematics" but rather "run away from Polish". Women, on the other hand, "run away from mathematics" towards the humanities, which gives them a sense of efficacy and control over their achievements as well as greater social approval.

The origin of school anxiety has not been fully explained; neither has its link to achievements. It is possible that anxiety about specific fields arises from a combination of poor skills with personality-related, neurological, and cognitive factors as well as social considerations (Maloney and Beilock, 2012). So far, however, research on mathematics anxiety, test anxiety, and failure anxiety suggests that these feelings are more intense in women. There is no conclusive evidence, however, that such feelings decrease their test performance to a greater extent than that of men in any field (e.g., failure anxiety has a stronger negative impact on girls' reading performance than on that of boys, though this pattern does not exist in mathematics).

Nonetheless, this does not mean that the cumulative effect of anxieties and lack of confidence will not push girls off the mathematics-oriented pathway when the opportunity arises. Recent studies on the stereotype threat have not confirmed the impact of episodic messages on lowering women's mathematical performance. However, the impact may be stronger when information about their abilities is multiplied and consistently transmitted over a long time. In social life, everyone, regardless of gender, is subjected to such stimuli. Various factors actively shape the social concepts of gender, whilst consolidating beliefs about women's and men's abilities and talents. In the long term, such concepts can influence educational decisions, making them consistent with the content of stereotypical messages. Women and men are, therefore, in a different situation. Teachers may not particularly address girls' lack of enthusiasm for mathematics, especially if they have other strengths. Better performance in biology, chemistry, or Polish partly justifies their lukewarm attitude towards mathematics, both in the girls themselves and in the social environment.

Men are in a slightly different situation. Their environment expects them to have high mathematical skills and, at the same time, does not require them to do well in the humanities, at least not to the same extent as girls. The field of their educational decisions is, thus, narrowed down to subjects that are socially perceived as "masculine".

The drop-out of women from mathematical pathways resembles the operation of a ratchet wheel. Questioning their competency already at the first stage of education demotivates and discourages them from trying to tackle this field later. However, the school admittance system (i.e., specialisations at higher levels of education) and informal selection based on stereotypes do not prevent girls with good skills from abandoning these pathways. The eyes of the schooling sieve seem smaller for girls and the outcome of such selection irreversibly excludes many competent women from the technology and engineering industries.

8

Social environment and educational choices

Agents of socialisation, with the family and school at the forefront, shape the school choices of individuals in a variety of ways. These mechanisms are not limited to supporting children's intellectual development at different stages. Among the qualities, dispositions, and attitudes that are formed in the course of socialisation, and at the same time influence the course of educational pathways, are emotional stability and the ability to use coping strategies to deal with success and failure, long-term planning and ambition, a tendency to compete and take risks as well as conscientiousness and perseverance. It is in the family that attitudes to school are formed, knowledge is acquired, and intellect is developed. It is there that it is decided whether educational achievements have a central or peripheral place in the system of students' aspirations.

In its typical course, the process of socialisation is by no means neutral with regard to gender. Gender is used as a compass by parents to determine what is considered appropriate, expected and acceptable in terms of parenting style, response, and behaviour. This chapter explores those aspects of girls' and boys' socialisation that may shape these non-cognitive characteristics and thus indirectly contribute to the different school choices they make.

8.1. Socialisation and reproduction of gender norms

There is a general consensus among researchers that it is through contact with the social environment that gendered social roles are formed. As researchers have increased their knowledge about the acquisition of social skills and the ability to operate in a world of existing norms, concepts of gendered socialisation have evolved. Until the 1960s and 1970s, the prevailing view arising from the then--popular theory of behavioural psychology was that a consistently applied system of reinforcement and punishment was an effective way of acquiring social knowledge, including that of gender norms. The basic assumption of behaviourism was that training by conditioning would lead to the association of desirable behaviour with positive messages (positive reinforcement) and inappropriate behaviour with negative signals (punishments). In the years that followed, research on children's cognitive development became increasingly sceptical of behaviourist conceptions of learning. It became clear that a system of reinforcement and punishment was neither the only nor the most effective way to regulate behaviour. It was found that behaviour could be shaped in much simpler ways. The transfer of knowledge about prevailing group norms does not occur through deliberate intervention but through spontaneous interaction with members of the community, and does not necessarily take place by means of open communication or through the enforcement of planned roles. It is generally based on subtle signals, suggestions, and nuanced information. These, over time, mould an individual in accordance with a gendered pattern and norm. These incentives are effective because the transmission of norms and behaviours between members of a group takes place mainly by means of observation. It is not a method unique to our species, but only humans have been able to make it an effective mechanism for transmitting culture across generations (Tomasello, 2015). Imitation, emulation, and instructional learning allow group members to gain knowledge about the world, its norms, and ways of solving problems. They also make it possible to learn patterns of interpersonal relationships. Children have perfected the ability to imitate. This involves faithfully copying the behaviour of other members of their environment (Speidel et al., 2021). Children do not only copy the behaviours that make sense and enable them to achieve something, but they also duplicate the behaviours that are not relevant and do not lead to a specific goal (Keupp et al., 2013). They perceive the patterns of behaviour presented by adults as the normal and appropriate way to take certain actions. Adults become a source of knowledge for them about how to react in an appropriate and correct way in a wide range of situations. By observing, children become aware of the sanctions that are applied when norms are not followed. They generalise the patterns they observe and transfer them to new areas. Research suggests that by the age of three, children have internalised norms to such an extent that they are able to assess, rebuke, and correct the behaviour of interaction participants who are noticeably breaking the rules (Rakoczy and Schmidt, 2013).

Similar rules apply to the social acquisition of gender norms. Sophisticated cognitive structures that enable the classification of people into female and male categories emerge as a child interacts with a model that represents "gender--appropriate" behaviour. These schemas are used to understand and interpret the behaviour of those around them. They also set the standards for one's own socially acceptable responses. These mechanisms – awareness of one's gender identity and the ability to categorise others as female and male – are therefore mutually reinforcing and can influence behaviour that conforms to gender norms from an early age. Some studies suggest that 2- to 3-year-old children who are able to identify their gender and that of those around them are also more likely to choose toys that are typical of their gender (Zosuls et al., 2009).

Gender identity has different dynamics in the course of an individual's development. As researchers emphasise, the most important stage in the process of shaping gendered behaviour is early childhood, when parents have an almost complete monopoly on messages reaching children and orienting their interests (Mesman and Groeneveld, 2018). Gender patterns that are internalised in early childhood, when subordination to norms is particularly strong and when imitation of behaviour is still the most important method of social learning, continue to develop. Around the age of 3, children are able to identify their biological sex, and for the next two to three years, they adhere strictly to this identity. During this time, they often avoid common activities that are inconsistent with their gender from a cultural perspective and avoid interacting with children of the opposite gender (Conry-Murray and Turiel, 2012). Children at this age also understand that their gender is an immutable part of the self, even if they engage in activities or wear outfits typical of the opposite sex (Perry et al., 2019). In subsequent years, greater flexibility is observed in moving beyond a narrow definition of one's gender. This shift allows for a more subtle classification of gender attributes. The previously sharply drawn boundaries of masculinity and femininity become blurred. During adolescence, there is another shift, again towards becoming stricter in conforming to gendered norms. It is worth noting that the periods of stronger identification with a cultural role model occur at important points in the educational cycle. The first occurs during childhood and coincides with entry into the education system, while the second occurs during adolescence when important decisions are made about educational and occupational futures.

Researchers agree that gendered social roles are constructed through interaction with the environment, but the phenomenon is so multidimensional that it defies single empirical models. Socialisation into gendered roles does not always take place in a direct way that can be observed using scientific methods. Some of the transmission of gendered roles takes the form of subtle and veiled messages, unspoken expectations or assumptions, and often occurs at a symbolic level. Judi Mesman and Marleen Groeneveld (2018) point out that parents carry out socialisation activities through indirect messages such as evaluating the gender-related behaviour of other people in the presence of their children. In parents' interactions with their children, messages with direct reference to stereotypes, such as: "dolls are for girls", are rarely conveyed. At the same time, such toys are likely to be present in the daughter's room. This may be one of the reasons why studies that involve the observation of parents and children do not show any differences in the parenting styles that are adopted towards boys and girls. In most respects, parents treat their children in the same way regardless of their gender. Meta-analyses show that differences in the treatment of sons and daughters have only been captured in a few areas – for the former, parents have used a higher degree of behavioural control (Endendijk et al., 2016). The fact that stereotypes and certain attitudes are not openly articulated due to norms in egalitarian societies may further complicate the identification of parental influences related to a child's gender. It is, therefore, impossible to analyse or quantify precisely the factors that influence schooling decisions. As a result, the study of the formation of women's and men's educational preferences is piecemeal, with analyses revealing only certain aspects of the impact of primary socialisation. However, a relatively coherent picture of the issue does emerge from the individual pieces of the puzzle.

8.2. Parents' expectations and attributions towards their sons and daughters

Parents' common conceptions of gender-related qualities and characteristics can have a variety of effects on their children's development. It has been found that boys are allowed to engage in risky behaviours. Their violations of social conventions are more tolerated, and their aggressive reactions are more acceptable (Morrongiello and Dawber, 2000). Parents of boys tend to support the pro-active behaviours of their sons (Hastings et al., 2004). Girls are expected to be more sensitive to social norms; they should show pro-social attitudes and empathy.

Parents attribute different cognitive abilities to their children depending on their gender. For example, research consistently shows that boys are believed to be more intelligent and to have better mathematical and spatial skills. These beliefs are held even when objective test results refute these assumptions (Furnham, 2001; Furnham et al, 2002; Gunderson et al, 2012; Peterson et al, 2019). It is believed that boys have inherent mathematical skills and girls' achievements in this respect are the result of their consistent work (Yee and Eccles, 1988; Gunderson, 2012). In view of this asymmetry, it is not surprising to see research findings that indicate that boys tend to rate their own intelligence and mathematics skills at a higher level than girls do (Steinmayr and Spinath, 2009). These findings also show that women have a consistently low opinion of their own intelligence and share a general belief that women are less intelligent than men. They also perceive members of their own families in this way. They consider fathers to be more intelligent than mothers and they consider themselves to be less intelligent than their brothers (Furnham et al., 2002). Girls are less likely than boys to believe that intelligence can be developed; they tend to treat it as an immutable characteristic (Diseth et al., 2014). This type of self-assessment of intellectual ability can be observed in children as young as preschool age. A study by Lian Bian's team found that 6-year-olds, both boys and girls, were more likely to attribute high intelligence to males than females (Bian et al., 2017).

It cannot be ruled out that the devaluation of women's intellectual abilities (by women themselves as well) has something to do with their attitude to mathematics. The common perception is that an innate talent, a "scientific mind", is required in this area, even at the school level. Indeed, strong mathematical and mathematical-logical skills have become synonymous with intelligence in many social contexts. In this way, a closed circle of cultural associations is created. Boys are perceived as more intelligent, as having better logical and spatial reasoning and technical skills that are closely related to mathematics, both by themselves and by their social environment. The qualities attributed to girls, such as empathy, good communication skills, and social awareness, tend to place them in the group of those "inclined towards the arts and humanities", which generally excludes them from the circle of "scientists".

Parental attributions can influence children's educational and career choices in a variety of ways. A number of studies by Jacquelynne Eccles (Eccles, 1994; Wigfield and Eccles, 2020) suggest that such influences largely shape sons' and daughters' opinions of themselves. Parents who thought their children were very good at English felt the same about themselves. Such analyses support the hypothesis that reinforcing a child's belief that they have certain abilities can contribute to their success in a particular area.

Parents' expectations of their sons' and daughters' educational performance also differ. Girls are generally expected to do better academically and choosing a different educational profile. Since the early 1990s in Poland, parents have recognised the benefits of tertiary education, but are more likely to want their daughters to graduate from university. In 1993, 47% of Poles wanted their daughters to study at this level, while 38% wanted their sons to do so. In the years that followed, aspirations for children of both genders increased significantly and the difference in parental expectations has largely disappeared. In 2009, 66% of respondents wanted their daughter to obtain a master's degree and 58% wished the same for their son (CBOS, 2009b). In 2017, the aspirations of parents had increased even more and became more evenly distributed between sons and daughters: 74% of respondents wanted a master's degree for boys and 73% for girls (CBOS, 2017a). At the same time, there were significant differences in what parents expected their children to study. The medical professions showed a particularly strong and persistent asymmetry. These were seen as suitable for women. Technical and engineering professions were considered more suitable for men. Profiles in education, the social sciences, and the humanities were more often chosen for daughters, as opposed to the natural sciences and information technology, where sons were more likely to be seen (CBOS, 2017b).

In certain aspects related to standards of behaviour and social roles, parents have different ideas about the abilities, qualities, and characteristics of their sons and daughters. Irrespective of the children's actual educational achievements or characteristics, these attributions are often stereotyped. The assumption that boys and men perform better in the field of technology and engineering is generally reflected in the day-to-day interactions to which they are encouraged from a young age. Irrespective of their actual skills, it is usually men who are entrusted with repairing household appliances, dealing with technical issues, and operating appliances of varying complexity. The repair of faults and defects is almost universally their responsibility. In 2018, in the majority of households in Poland (81%), they were the ones who took care of minor repairs (CBOS, 2018b).

8.3. Social environment and attitude towards mathematics

It is through the transmission of values and attitudes towards education that school preferences are socially shaped. In the case of mathematics, parents' attitudes towards the subject, their own levels of mathematics anxiety, their beliefs about the importance of the subject in relation to other school subjects, and their wider life plans may be relevant. If parents themselves feel insecure about the subject or openly express negative feelings about it, there is a greater risk that their children will become discouraged about mathematics. Because attitudes towards mathematics are "contagious", the preferences and attitudes of those closest to students can play an important role in shaping their attitudes. Research carried out by Erin Maloney and colleagues found that children whose parents were afraid of maths tended to feel similar. Research also showed that the transmission of maths anxiety between parents and children mainly occurred during joint homework, when adults, in an attempt to help, revealed their own fears and insecurities in this field (Maloney et al., 2015). Mothers may play a greater role in this process, as they are more likely to help children with their homework. However, their maths anxiety may be higher on average than that of fathers. Research suggests that men's anxiety has also contributed to an increase in similar feelings in children (Szczygieł, 2020). Betina Casad, Patricia Haye, and Faye Wachs found that attitudes to maths were transferred more often in daughter-mother and son-father configurations than in male-female pairs. That is, when the female dyad had low levels of maths anxiety, daughters had more positive attitudes towards the subject than when mother and daughter had common anxiety in this domain (Casad et al., 2015). Irrespective of other factors, it is possible that this mechanism contributes to the reproduction of attitudes towards mathematics from one generation to the next in the long term. Such patterns may be passed on, even unconsciously, to their daughters by mothers who themselves have negative attitudes towards the subject, question its importance, and feel insecure about using knowledge in this area. A large number of studies confirm the importance of the emotional level and favourable social conditions for the development of mathematical skills and attitudes towards the subject.

8.3.1. Impact of social networks

Attitudes towards mathematics, and how it is perceived and valued, are factors that operate through "social contagion". This mechanism can contribute to spreading anxiety and devaluing the role of the subject. However, it can also have the opposite effect. Women's interest in male-dominated fields of education is positively influenced by significant others, their attitudes, and the behaviours they represent. This has been shown, among others, by studies of people who have chosen to pursue careers in mathematics. A study of female students at a Polish university of technology found that the social circle of these women tended to include people who also had an engineering background; they had either graduated from or were in a similar course of study or were working in a sector related to technology and engineering (Zawistowska, 2017). For women with high mathematical ability, the presence of significant others in the social network may tip the balance when deciding on an educational pathway. As opposed to those outside their immediate circle, those close to them are the most reliable source of information about how to operate in a traditionally masculine field. Frequent contact with the role models in the immediate environment allows women to look closely at the consequences of their educational choices, to analyse them directly, and to relate them to themselves. According to Albert Bandura's (1997) theory, this is one of the pillars of building self-efficacy beliefs. The survey of female engineering students also showed that contact with a role model with professional or educational experience in engineering disciplines allowed them to overcome fears, preconceptions, and stereotypes, and to test their own unfounded perceptions regarding the choice of technical fields of study. In fact, the statements of the female students interviewed indicated that even possessing adequate mathematical competency and having the desire to pursue engineering careers did not stop them from feeling that they were "trespassing" when they entered the technical university. The presence of significant others mitigated these fears to an acceptable level by providing reliable information and taming the prospect of entering a male-dominated milieu (Zawistowska, 2017).

The "social contagion" mechanism of spreading unconventional behaviour in the social network (and women's choice of heavily male-dominated studies can be seen as such) is sometimes even more effective when another woman is a role model. Jane Stout and colleagues (2011) used the metaphor of a "vaccine" to describe this regularity. They argued that the presence within a woman's social network of a female expert with sufficiently high mathematical skills can immunise against the effects of harmful stereotypes, just as a vaccine protects against a virus. Contact with a role model not only reduces the level of anxiety associated with transgressing cultural norms but also reduces the feelings of inadequacy and alienation that female engineering students experience as a result of being in the minority. Such beliefs, caused in part by a lack of sustained, secure interactions with like-minded people, lead to anxiety, isolation, and feelings of being out of place (Baumeister and Leary, 1995). Exacerbating these feelings may be one reason women choose not to study engineering and pursue such careers. This effect has been described by Carroll Seron, Susan S. Silbey, Erin Cech, and Brian Rubineau (2016). They observed that as female's self-identification as engineers declined, female engineering students gradually lost their sense of belonging to a community of students. The loss of identification with the profession, the range of tasks and the community, and the resulting insecurity, forced female students to constantly reaffirm their own competence within their academic community. In contrast to women, men did not have to be on the lookout for community acceptance – they were, after all, "at home".

Evidence from research on the role of the significant other confirms that attitudes to mathematics are shaped by interactions with the social environment and that this process begins before the start of formal education. In this respect, mathematics is a unique field compared to other school subjects. While parents with more social and cultural capital place the emphasis on developing their children's language skills (e.g., by developing reading habits and conversation), mathematics education at home generally takes a back seat to everyday interactions. It is usually a conscious decision by parents to introduce mathematics-related activities, games, apps, and number cards into the life of a child as young as a few years old, if at all. It can be assumed that children of parents with a higher level of education will have a more supportive environment for the development of early mathematical competence (Elliott and Bachman, 2018). Those from lower SES families are more likely to start the first year of school with deficits in the basic mathematical skills of operations and establishing relationships between numbers, which they generally do not make up in subsequent years of schooling (Jordan and Levine, 2009;

Ribner et al., 2023). These studies show that the development of mathematical competence is strongly influenced by their social environment. They also show that well-designed preschool education can be effective in preventing gaps in knowledge at later stages of education. The analyses also show that for most children, mathematical competence is not the product of innate talent, but rather the result of effective mathematics education that begins at an early age.

In many situations, in the early years of child development learning is spontaneous and unplanned. Everyday activities that have nothing to do with formal education provide opportunities to come into contact with numbers and mathematical operations. These include cooking, shopping, paying bills, and using the calendar. These situations can be conducive to the development of positive attitudes towards mathematics but can also have the opposite effect. The tension, frustration, and lack of confidence displayed by adults in such situations are factors that can become invisible but persistent building blocks of negative responses to mathematics. Parents' maths anxieties and negative stances on the subject are transmitted to children (Soni and Kumari, 2017; Szczygieł, 2020).

This conclusion is not surprising, given the role that parent-child communication style plays in cognitive development. Research shows that children pick up the vocabulary used by members of their immediate environment and, together with their lexical stock, shape their way of thinking about the world, relationships, and dependencies in it. Children of well-educated parents have an advantage in this respect. Working with more complex linguistic structures, they can nuance descriptions of reality and use generalisations when necessary. When it comes to developing mathematical skills, this mechanism may work somewhat differently, as these are less correlated with social status than verbal skills. For example, some studies suggest that quantifying language helps children become familiar with protomathematical concepts. Irrespective of social status, parents who use terms that describe spatial and temporal relationships or represent objects numerically in everyday communication contribute to the development of children's spatial reasoning skills (Levine et al., 2010). However, language is the vector of mathematical contents and operations. Thus, linguistic competence can give an advantage to students with greater cultural capital.

8.3.2. The role of protomathematics training

Mathematics is used in everyday situations outside school. Examples of activities where basic mathematical skills are useful include card and board games, shopping, managing pocket money, planning expenses, and calculating the time needed to get to school. The more frequent the exposure to such stimuli, the better the development of mathematical thinking will be (Young-Loveridge, 1989). Of particular interest is the influence of toys on the development of mathematical skills in the youngest girls and boys and their potential impact on children's attitudes towards mathematics. There are a number of methodological problems for researchers in determining whether the choice of gender-specific toys contributes to differences in attitudes towards mathematics and mathematical skills. There are at least three links in the chain of inference. The first is to determine whether toys influence children's cognitive development, the second is to determine whether a child's gender influences the choice of a particular type of toy, and the third is to find out what the effects of these variations are. Developmental psychologists generally agree that children's interactions with toys stimulate their cognitive development at an early age (Dauch et al., 2018). Babies and young children train their motor skills and perception as they shake and bang toys on different surfaces, and these activities are an introduction to more advanced, conceptual activities later in life.

Research also shows that children's toy preferences vary by gender (Weisgram et al., 2014). The intensity of these differences depends on age, level of motor and cognitive development, and stage of gender identity development. Dynamic studies show that 2-year-olds (in contrast to children a few months younger) are able to make more accurate toy classifications based on the compatibility of the cultural norm with their biological sex. Older children are even more selective in their choices. Between the ages of three and six, they enter a period of "rigidity" in their definition of their own gender (Halim et al., 2014). Overall, research shows that boys are more interested in toys with moving elements and those that facilitate exploration of the environment and physical engagement (e.g., cars and blocks). Girls, on the other hand, show a preference for toys that focus on aesthetics and promote sociability (Boe and Woods, 2018; Davis and Hines, 2020). Children's preferences for gendered toy choices are also supported by meta-analyses that include different research contexts and use different methodologies (Todd et al., 2018).

Do these preferences have an impact on the development of cognitive and non--cognitive skills? The educational effects of construction toys, which allow objects to be built (freely or according to instructions), have received particular attention from researchers. Research suggests that such toys can help develop spatial skills, which precede the acquisition of mathematical skills (Casey et al., 2008; Levine et al., 2012). Skills such as estimating size and weight, scaling patterns, and transforming and matching shapes are activated by stacking blocks and puzzles. Building blocks, especially when they reproduce a specific pattern, are a good exercise in symmetry, transformation, balance, and matching pieces. Evidence suggests that children who are particularly good at reproducing structures presented to them have an advantage in mathematical skills over children who play with blocks less often. In a series of studies, a team led by Brian N. Verdine (2014) asked children as young as 3 years old to reproduce a given building out of blocks and then measured their mathematical skills using an appropriately calibrated test. The results confirmed that, regardless of the child's gender, the accuracy of the constructions had a positive effect on the results. However, the SES of the child and, more specifically, the presence of spatial terms in everyday family conversations became more important. Parents with a higher social status are also the ones who are more likely than others to use terms that describe spatial relationships at a more detailed level in their conversations with their child (Ferrara et al., 2011). This confirms that the social environment of children can stimulate and shape spatial thinking, a key component of mathematical skills. The style of communication between parents and children becomes, to some extent, their medium.

Construction toys reinforce some components of spatial skills, but do they do it equally for girls and boys? Research suggests that the consideration of differences in experience, for example through play, does not fully explain the advantage of boys in spatial skills (Jirout and Newcombe, 2015). However, it is important to note that gender differences in spatial skills are relatively small in young children, and only increase with age (Lauer et al., 2015).

For older children and adolescents who attend school, the place of construction toys is taken by activities that are more cognitively complex, including video games. Research suggests that certain video games improve spatial skills over relatively short periods (Feng et al., 2007; Cherney, 2008). A study by Anne Gold (Gold et al., 2018) found that, on average, students who played computer games scored higher on an object-spatial imagery test than those who did not. Among gamers, there were no gender differences in spatial ability, in contrast to the non--gamers – where men performed better. However, after several hours of training with the stacking and shape-matching components, the difference between the genders on the rotation test was reduced, with the women scoring relatively higher, although it is possible that this was influenced by their lack of prior experience in playing games, making them relatively more likely to benefit from the training. This is supported by research by Kaveri Subrahmanyam and Patricia Green (1994), who did not find that women's spatial skills increased following training. They did find, however, that it was significant for those who had little experience of this type of activity, compared with those who had more experience. Perhaps even more than gender, the results of these studies were determined by the "ceiling effect". This occurs when the value of a characteristic is close to its maximum to begin with, and the effect of the experimental manipulation does not significantly alter its value. For example, if men who participate in this type of research are accomplished in the skills required to play the game (using the pad and keyboard, understanding the logic of the game), the gains they make after training may be relatively lower than those made by women who lack such experience.

These and similar studies also demonstrate another regularity. The implication is that spatial orientation is something that can be shaped and developed through appropriate training and systematic stimulation. This opens up the field for designing various educational innovations that, by stimulating spatial skills, could bridge the experiential gap resulting from gendered socialisation patterns.

People's perceptions of their own abilities are strongly influenced by the opinions of those close to them. Parents' beliefs about their children's abilities are the building blocks of their own judgements, their own sense of competence and their own agency (Frome and Eccles, 1998). Judgements about self, formed on the basis of messages received from those close to us, shape our beliefs about our ability to succeed and influence the choice and avoidance of certain goals. These beliefs may influence different educational aspirations, academic achievement, and also how women and men perceive their abilities. It is very likely that gender-differentiated socialisation contributes to the fact that from an early age, boys gain confidence in their abilities in mathematics and sports, while girls are more likely to value their language and social skills (Wigfield and Eccles, 2002). Both direct messages from parents and more subtle suggestions or expectations shape these differences. This can happen through the shaping of the child's interests or the choice of specific activities (for example, types of play). It is possible that mathematics and the skills associated with it occupy an important place in the socialisation of young boys. Parents' stereotypes, not always realised, reinforce their sons' belief that boys succeed in this area. In turn, parents' stereotypical thinking may undermine their daughters' self-confidence and lead them to play down the importance of mathematics in the hierarchy of school subjects.

8.4. Impact of school on attitude to mathematics

The school, and more specifically the social ecosystem that operates within it, is the second important link in socialisation, after family. As with the family, interactions with school actors are intense and prolonged, and the school itself becomes a beacon of desirable behaviour and achievement

(Evans and Field, 2020). There are a number of ways in which interactions with teachers and peers influence the course of school careers. One of these is the gender attributions made by teachers. A Polish study shows that teachers of younger children make different assumptions about the personality and intellectual characteristics of boys and girls (Kopciewicz, 2004). To behave well, to follow school rules, to be more conscientious and disciplined – such expectations more often tend to apply to girls. At the same time, early childhood educators' perceive girls as more helpless, less motivated, and less flexible than boys. They are more likely to withdraw when they are confronted with new situations. In contrast, boys were perceived as troublemakers, disrupting the classroom and needing extra attention, while at the same time, their level of independence, activity, and commitment were emphasised. According to teachers, male and female students also differ in their working styles. Boys tend to be more efficient and tend to act to get things done correctly, while girls tend to focus more on aesthetics. This difference is one of the factors which makes boys more intellectually attractive partners for teachers in the younger classes, despite the fact they behave disruptively (Kopciewicz, 2004; Goś, 2007; Chmura-Rutkowska, 2012). Especially if, despite their nonchalant approach to norms and relatively low effort, they achieve relatively high results in school. Such students are considered more intelligent by their teachers and are also more popular among their peers (Heyder and Kessels, 2017).

Other school contexts also manifest perceptions of male and female students through the prism of different traits. Ewa Muszyńska (2004) suggested that teachers locate the source of female and male students' success differently, attributing talent to boys and diligence to girls. Expectations and ways of rewarding and punishing are different according to gender, and male and female pupils read these signals and fall into the roles that have been prepared for them. Małgorzata Drost-Rudnicka (2012) found that third grade students were assigned additional school tasks on a gender-specific basis. Caring for the classroom, preparing occasional decorations, and keeping the classroom tidy were activities that were generally considered appropriate for girls, while moving desks or collecting brushwood for the bonfire during the school trip were assigned to boys.

The origins of these differences can be explained in the first place by the operation of the cultural norms that the children have observed in the family home. Gender stereotypes at school are usually based on and reinforced by the primary socialising environment. The work of Lucyna Kopciewicz, a critical educational researcher, showed that female early childhood educators believed that women's natural nurturing, maternal feelings and emotional warmth made them better suited to working with young children. According to the female teachers, contraindications to employing men as educators in the younger classes included harshness displayed in their relationships with children and the lack of maternal instinct. Female participants in the study believed that men's "cold and harsh" behaviour could make it difficult for children to develop the friendly relationships they need at this stage of schooling, and by making higher demands, they could make children feel anxious about school (Kopciewicz, 2004).

The stereotyping in teachers' thinking is in contrast to the changes that have taken place in the portrayal of masculinity and femininity in school textbooks. Dorota Pankowska (2004), who analysed books used in early childhood education, argues that in the 1980s, boys were the main protagonists. They appeared significantly more often in almost all contexts typical of children, be it sports, arts, or care. Two decades later, at the beginning of the 21st century, the disparity in the frequency of girls' and boys' appearances in textbooks had narrowed and the various activities in textbooks were increasingly performed by children of both genders. But not everything has changed. Unacceptable and risky behaviour was still shown as the domain of boys, although it was more common to present girls as disobeying and climbing trees (Pankowska, 2004).

8.4.1. Effects of teachers' beliefs on students' performance and attitudes

Research suggests that teachers – as well as parents and pupils themselves – use gender stereotypes. They can influence the attitudes, choices, and mathematical performance of male and female students in a similar way to what happens in families.

The teaching of mathematics is based on two foundations – mathematical competence and teaching skills. Ideally, the two are closely linked, as good subject knowledge gives teachers the freedom to organise the teaching process and makes the repertoire of teaching resources being used broader and more flexible (Czajkowska et al., 2010). Having better mathematical skills means that the teacher feels more confident and less anxious about mathematics. For this reason, the way in which early grade teachers are recruited is an important part of the mathematics teaching process. Research shows that majors of early teacher education attracts secondary school leavers with lower mathematical skills. It is often seen as an escape route for those not wishing to enter the maths-related field. This phenomenon is confirmed by the results of the Polish part of the International Teacher Education and Development Study in Mathematics (TEDS-M), (Czajkowska et al., 2010). In 2008, almost half of female students of pedagogy majors reported low or average results in mathematics at secondary school. These self-reported opinions were confirmed by studies on the mathematical competence of female students preparing to work with younger pupils. In a standardised test of mathematical knowledge, only a quarter of the respondents scored above the average, placing Polish female students of early childhood education in second--to-last place in the ranking of countries with comparable education systems. On the other hand, male and female candidates for higher-level mathematics teachers performed much better in terms of their skills in cross-country comparisons. However, these are incomparable categories, as they often include those who have specialised in teaching mathematics.

It is possible that the mathematical knowledge of future early childhood teachers, even if incomplete, should be sufficient to cope efficiently with the presentation of material at this level of education. The style of teaching will, however, be influenced by the level of knowledge. Beilock and colleagues (2010) found that mathematics anxiety and low self-esteem in teachers' abilities led to rigidity in their teaching. Such teachers were limited to teaching in a routine way, using textbook methods and examples, and were not motivated to introduce unconventional teaching strategies. A similar regularity was noted by Marcin Karpinski and Malgorzata Zambrowska (2015) in a study conducted in Polish schools. Female teachers of third graders had a more traditional teaching style and a preference for easier tasks. Researchers linked such attitudes to the mathematical anxiety prevalent among teachers at this grade level, who were predominantly female (almost 90%). Mathematical anxiety contributed to evasive behaviour and rigidity in the teaching process, which was manifested in the fact that female teachers did not accept non-standard solutions to tasks proposed by the pupils and limited their attempts at independent reasoning when they deviated from the textbook procedures. Teachers' insecurity, as highlighted by the researchers, encouraged students to repeat the same ways of achieving a result, rather than seeking creative solutions. Similar patterns were found in higher grades (Karpiński and Zambrowska, 2015). Higher levels of anxiety towards mathematics among female students of education in comparison to women students of other subjects have also been found in other studies (Szczygieł and Cipora, 2016).

Anxiety about mathematics, underestimation of one's own abilities, as well as a belief in the low importance of this subject are factors that, if internalised in the course of one's own education, can influence the rigidity of the didactic process regardless of the skills of the educators. They can also be passed on to the students. There is a reason to believe that this effect may vary according to the gender of the students. This hypothesis was tested by Sian Beilock's team (2010). Comparing the mathematical skills of primary school pupils at the beginning and end of the school year, the researchers found that the higher the level of maths anxiety among female teachers, the lower the achievement in the subject among girls, who also developed the perception that maths was a "male subject". No decline in achievement or deterioration in attitudes was observed for boys (Beilock et al., 2010). This difference may be due to the role model function of female early years teachers for girls. In the eyes of younger children, they become role models, representing a desired style of behaviour and attitude. Pupils pick up on the subtle messages sent by female teachers, decode seemingly insignificant emotional responses, and sometimes, over time, reproduce fearful responses to mathematics. The process of discouraging mathematics learning may take place outside the teachers' own awareness. Focusing girls' attention on non-mathematical skills, the enthusiasm for their elegantly calligraphed handwriting or the delight in their ability to read fluently, may reinforce pupils' belief that they have mastered these skills and should improve them. Mathematics may fade into the background and become a second-choice subject that, although not difficult, does not evoke the same sense of competence and agency that pupils with high competence in reading may experience. This contrast may be one of the reasons for the emergence of mathematical insecurity in the early school years. The sources of female insecurity in mathematics lie not so much in the direct messages that it is a "boys" discipline', but in the stronger messages about girls' non-mathematical talents. Such messages can divert attention to other types of activities.

8.4.2. Teachers' stereotypes and mathematical choices of male and female students

Gender stereotypes can have a variety of effects on male and female students. Research suggests that teachers' stereotypical beliefs may contribute to women's underachievement in mathematics, exacerbating their insecurities and increasing their risk of abandoning mathematics education. Girls who had teachers in secondary school who strongly believed that maths was a field for boys and humanities for girls held similar views at the end of their education at that stage (Carlana, 2019). However, teachers' expectations may not only undermine female students' confidence in their mathematical skills but also contribute to the perpetuation of the belief that male students are less competent in reading. This can be particularly damaging for underperforming boys, who, due to their shortcomings, fall off the teachers' radar and are stuck with the label of a "poor student" who is not expected to progress.

There is another way in which the influence of stereotypes can manifest itself. However, this has changed in recent years. The extent to which school grades are translated into standardised test scores is one way of checking for bias in the assessment of ability. If the marks given by teachers were a fair reflection of the abilities of the students, they would be a good predictor of the results of external tests that are administered in an unbiased way. However, many studies suggest that the relationship between how well students perform in school and in external tests is relatively loose. It may be particularly true for girls. In the Czech Republic, Norway, Portugal, and the UK, female students who scored the same as boys on a standardised test in mathematics had higher school grades in this subject (Protivínský and Münich, 2018). These studies suggest that girls' scores in standardised tests were lower than their school grades would suggest. The opposite was true for boys (Graetz and Karimi, 2019). This would imply that teachers give girls higher marks than their abilities would suggest. One source of this bias could be the female advantage in non-cognitive skills. The stereotype of the "polite" female student may, to some extent, neutralise the perception that they have lower mathematical abilities and consequently result in them being awarded higher marks. In other words, in the eyes of teachers, they "make up" for their perceived lack of mathematical talent through hard work, conscientiousness, and diligence (Robinson-Cimpian et al., 2014). Research by Dorota Turska and Urszula Oszwa (2017) also indicated the existence of bias in mathematics teaching. On a sample of Polish teachers they proved that teachers with traditional views, i.e., those who claimed that mathematics was a male domain, rated female students' mathematical skills lower. Teachers with gender-neutral beliefs attributed mathematical achievement to students' work, while biased teachers linked it to gender stereotypes. These attributions may have a long-term impact on women's confidence in their mathematical competence.

One might ask how positive bias affects the level of self-assessment of mathematical competency. Since women may receive grades that are inflated relative to their actual ability, school grades cease to be a reliable educational signal and become partly a reward for behaving appropriately in the classroom. Students themselves and their social circles notice this strain and realise that assessment is only partly about knowledge. As a result, school grades cease to be a reliable consideration in making educational choices. As the above studies show, grades can be a misleading signal, especially for girls. The paradox is that, at least in the case of mathematics, a positive bias towards girls does not necessarily help them develop a sense of confidence in their mathematical abilities. What is more, knowing that you have been rated too highly can make you feel insecure about your competency.

8.5. Summary

This chapter looks at some of the ways in which social environment influences how females and males think of themselves, how they perform, and the choices they make about education. The influence of the family and school, which have the greatest impact on shaping children's cognitive and non-cognitive development, has been of particular interest. Existing research provides strong evidence that these two environments shape girls' and boys' preferences, interests, and opinions about themselves in different ways during the early stages of a child's personality and cognitive development. This is done to a large extent by shaping their beliefs about their strengths and weaknesses, building up their confidence in their abilities, and influencing their assessment of the potential they have to achieve a given goal. The social environment pushes children to develop certain skills, interests, and attitudes. These are generally in line with socially ascribed gender roles. The image shared by parents and teachers of the good and conscientious student may have contributed to the intergenerational advancement of women in the education system. They have been more likely to choose educational institutions where this pattern was particularly expected (e.g., secondary schools leading to the *matura* examination and higher education institutions). Although parental expectations of their sons and daughters have more or less converged, the acceptance of behaviour which challenges school values and discipline remains lower in the case of girls. This positive stereotyping, which may have pushed girls towards more demanding types of school and protected them from anti-educational practices (truancy, lack of academic progress, dropping out of school, and so on), may also have skewed their perceptions of their own ability. Students recognise that behaving in accordance with teachers' expectations can help them achieve slightly better results in school, but in external examinations, they can only rely on their own learning. Before they take these examinations, students need to develop confidence in their ability to succeed and a belief that they have a realistic chance of achieving their goals. These are the elements on which self-assessment of competence is based. The research shows that it is more difficult for girls to adopt this way of thinking because they absorb the perceptions of teachers and parents. In particular, parents' opinions about their children's abilities strongly influence their awarenesses. Girls are susceptible to suggestions and signals that mathematics is not their field and that they can do without it in their future educational and professional life. A combination of factors – ranging from the toys and activities offered to girls in early childhood, to what their parents think about them, and interacting with teachers – provide a basis on which women's mathematical uncertainty will develop. When the object of aspiration is outside the field of social convention, the feeling of having a high level of competence seems to be a particularly important motivating factor. This is the case for women who decide to pursue a career in the engineering and technical fields of work. These aspirations require them to have a greater sense of self-efficacy and self-confidence, as they involve the transgression of stereotypical social roles. Having a strong belief in having high mathematical skills can help to enter the "Man's World".

Conclusions

The level of educational attainment is one of the most important factors, if not the most important, that distinguishes post-war generations in Poland. Considering the inertial nature of the social structure, whose hierarchical arrangements are more likely to persist over time than to change progressively, a revolution has taken place in the field of education. Gender, along with social status and associated cultural capital, is one of the factors that has differentiated the nature and pace of participation in this change. Educational progress affects both men and women, but it is women who have become the protagonists of this publication. Before they began to spearhead educational change and contribute to increasing enrolment through their choices, they operated on the fringes of social, economic, and political life. This has changed in the last few decades.

The central theme of my reflections was to document and understand the pattern of this change. I analysed the intergenerational transformation of education attainment and school preferences as well as the choices of women and men using a variety of data sources, including public registers and national and international surveys. When possible, I took as long a time perspective as the available empirical material allowed. I wanted to understand not only how women's educational expansion came to be but, above all, to comprehend the nature of the phenomenon. Educational choices are subject to mechanisms of intergenerational reproduction and it is only in the long term that the cumulative effect of the choices of successive generations becomes visible. A comparison of the educational trajectories of people born in different periods shows that there has been a clear improvement in the educational attainment of women and men in the post-war period at the secondary school level and also at the tertiary level over the last two decades. However, there are significant differences in the structure of educational attainment between men and women. Decisive for the emergence of these differences were the choices that were made after primary school. As soon as the post-war generations were able to stay longer in the education system thanks to educational reforms aimed, among other things, at increasing school enrolment rates, gender differences in preferences at this level became apparent. This was influenced by the development of primary education and the increased educational opportunities after this stage. Basic vocational schools, which enabled a large proportion of young people born in the 1950s and 1960s to obtain a vocational qualification relatively quickly, experienced the most intensive development. Training for simple (usually menial) jobs in industry and construction was the main focus of these schools. Only a small proportion of women chose to continue their education in these schools, and if they did, they were trained in feminised profiles related to commerce and service. The effect of such selection after primary school was an increase in the proportion of women in secondary education, especially in general secondary schools, which, unlike basic vocational schools, offered the possibility of obtaining the secondary school leaving (*matura*) certificate. This certificate has played an increasingly important role in the educational and professional biographies of women, as evidenced by the fact that in each successive generation, more and more of them opted for secondary education leading to the school-leaving certificate. The desire to improve labour market prospects may have been the motivation for studying at general secondary schools. In these schools, education lasted longer than at vocational schools, was more demanding, and was based on a programme that essentially covered a wide range of knowledge in different fields. Moreover, in the 1950s and 1960s, women were not welcome in the almost all-male workforce in factories and industrial plants. Neither manual workers, management, nor society as a whole wanted them to work in the industrial sector. The choice of a general secondary school, which was more demanding, opened up greater career opportunities in white-collar professions, in offices or administration for women.

The analyses of the collected research materials confirmed my initial assumption that the emergence of different educational pathways for men and women was a multi-causal phenomenon with complex origins. These include the massive increase in the number of women entering the labour market and the increasing dependence of jobs upon education. It is worth noting that women's paid work was a fairly common phenomenon even before the authorities of the People's Republic of Poland proclaimed the concept of their emancipation by including them in the plans to modernise the economy after the World War II. Although women were not new to the world of work, in the post-war reality of modernising the economy, their lack of education meant that they were relegated to the lowest-paid jobs in factories. Improving their professional position was also hindered by the traditional conservatism of men, who did not accept the presence of women in certain professions and in higher positions in factories.

The situation was slightly better for younger generations of women who, unlike their mothers and grandmothers, had the opportunity to receive a formal education. Women received lower wages than men with the same education, but the diploma they obtained improved their professional situation and salary more than those of men. In the 20th century, men with vocational or even primary education could expect to earn more and find better jobs than women with the same qualifications. This argument, in addition to the lack of acceptance of women in male working-class occupations, may have been a factor in their preference for general secondary education, especially since job opportunities in middle-level white-collar professions have opened up for them.

More than any other changes in the past, the period of political transformation and the deregulation of higher education in the 1990s have stimulated the educational aspirations of Poles. Hundreds of thousands of young people have taken advantage of the opportunities for access to higher education – both public, with and without fee payment, and private education. For the young people who chose to continue their education in the mid-1990s, studying for a degree was a hedge against the effects of high unemployment and hyperinflation, but for later generations, it has become a way of improving career prospects and increasing opportunities for self-fulfilment. However, women were significantly more likely than men to choose to study at an HEI. And for women, the effort was more likely to be rewarded with a degree. At the turn of the 21st century, men who made educational choices after secondary school were, on average, less likely to choose to study at an HEI, and as a result, a large gender gap in educational attainment has emerged in the generations born in Poland after the political transformation.

Contributing to this phenomenon is (among others) the impact of tertiary education on the labour force participation of men and women. The latter were more affected by the changes associated with the political transformation in the early 1990s. The deterioration of their labour market situation was caused not only by higher unemployment in general but also by the withdrawal of the state from the social sphere. Even after the years of the deepest crisis, women were more likely to lose their jobs, were less active in the labour market than men, had interruptions in their careers due to maternity, and received lower wages on average. Women were also less confident about their career future – both new entrants and experienced workers were more concerned than men about unemployment. The difference between men's and women's perceptions of career opportunities was noticeable both in the mid-1990s and in recent years, when unemployment was at low levels.

When comparing information on the women's labour market situation with their higher educational aspirations, I hypothesised that formal education is a kind of hedge for women. It is only at the tertiary level that the two genders are on an equal footing in terms of basic labour market indicators. Women in this education category were as active in the labour market as men, had similar levels of employment, and had a university degree that protected them from unemployment to the same extent as men. Women with lower levels of education were disadvantaged compared to men in each of these dimensions. Only a university degree protected women from a labour market disadvantage by reducing economic risk to an acceptable level.

Women were motivated to study even when the benefits of a degree were no longer as significant as the premium they received in the 1990s; however, the situation is different for men. Since 2010, there has been a decline in young people's aspirations for tertiary education, but this process affects men more. They are more likely to have opted for a professional career and to have skipped this stage of education. This phenomenon, especially for graduates of non-selective fields of study, may be linked to a reduction in the benefits of obtaining a diploma. It is possible that the decision not to go to university or to drop out of higher education before obtaining a diploma was taken mainly by men who were able to earn a high income without having to take exams and continue their education. In particular, those graduating from technical schools were on average less likely to go on to study than those graduating from general secondary schools. In the case of those born at the end of the 20th and the beginning of the 21st centuries, the stage of higher education was an important determinant of the gender gap in educational achievement. Men were more likely to choose technical schools, which reduced their chances of going to university, than upper secondary schools.

A more general conclusion can be drawn from the above findings. In a situation of relative economic stability and at the same time declining or insufficiently attractive returns from education, the motivation to stay longer in the education system diminishes. Such decisions are made in particular by men, who are generally more sensitive to the signals of the economic equivalents that can be obtained without going to university. Moreover, their motivation to stay in the education system for a long time is reduced if there is no pressure from the surrounding social environment to get a degree. Women are less likely to be influenced in their educational decisions by the economic returns from spending time on education, as can be seen from the research collected.

In addition to economic motivation, the behaviour of male and female students at school is a second factor contributing to the gender gap in educational attainment. In some aspects, women are better at meeting the demands of school. They tend to have higher educational aspirations and to want to stay in education for longer than men, they are less likely to engage in overt anti-school behaviour and they are less likely to repeat a year of schooling. Girls also perform better on average than boys in subjects that stereotypically should not be their domain. Female students are also more conscientious than boys, more determined to achieve school goals, and more focused on knowledge acquisition and intellectual development. A number of skills (e.g., social skills) already give them an advantage when they enter the education system. On average, women's greater adaptability may reduce the effort they put into learning, and may also lead them to stay longer in the education system.

The vertical educational structure is only one dimension of the education system. Another is the horizontal dimension, defined as fields of study, and learning profiles. Formally, students choose a particular profile in secondary school, but their attitudes towards certain fields of knowledge are formed almost from the beginning of their education. In the case of mathematics and reading, two central areas of education, these attitudes differ quite significantly by gender. The main influencing factors are belief in one's own abilities and capacities, assessment of one's chances of success, and value of the subject area in life. Those who strongly believe in their own maths skills and link further education and career plans to the subject are more likely to choose maths education. In Poland, girls rate their mathematical competency lower than boys do, even at the beginning of schooling, and this difference persists until the end of early childhood education. The lower self-assessment of mathematical competency remains even when the actual level of mathematical competence is taken into account. Boys have an advantage in the group with high test scores where male and female pupils are at similar levels of competency. This advantage probably partly contributes to the fact that more males than females opt for the extended *matura* exam in mathematics. This opens up opportunities for further education in maths-related majors. However, even after controlling for differences in ability, boys were still more likely to choose maths for the extended *matura* exam, which confirms the hypothesis that skills are an essential element to make educational decision, but certainly not the only one.

It is possible that a more important factor than mathematical ability is the different ways in which female and male students tend to view mathematics and different belief in one's own competences. One's own judgements largely reflect the beliefs that are embedded in the social environment. The belief that boys are more predestined for careers in mathematics-related fields persists in the family and at school, the two environments that have the greatest influence on the formation of children's self-image. Such beliefs, even if they take the form of subtle, unexpressed signals, form a coherent message that boys and girls receive on different occasions. In the long run such messages facilitate women's rationalisation of the process of disengagement from mathematics; their decisions in this context are in line with the "social norm" and not an aberration. Men, on the other hand, are convinced by the messages they receive from those around them that they are able to cope with mathematics and skills in this field will be useful to them in the future. These invisible advantages provide a psychological reservoir of confidence in themselves and their abilities, which not only makes choosing mathematics seem natural to them but also fits well with their expected risk-taking and higher tolerance for failure or criticism from those around them.

For those boys who construct their beliefs about their mathematical competency on the basis of socially reproduced stereotypes rather than their knowledge, these skills will undoubtedly be particularly useful.

Uncertainty, anxiety, hesitation, and lack of confidence in one's own abilities ultimately lead women off the educational path leading to a career in mathematics. Majority of them tend to choose social sciences instead of science, the advanced level *matura* exam in Polish or history, and not in mathematics. Their high grades in many subjects, particularly those requiring high reading skills, may partly explain this. Females, in line with their test scores, mastered such skills at a much higher level than males. They also tended to feel that they were valued. Female students' school achievements, but also the high expectations of their competencies from their social environment, may contribute to the creation of a "humanist" rather than a "scientist" identity, and encourage them to choose careers outside mathematics.

It is probably easier for women to make the decision to withdraw from mathematics than it is for men also because most of them have an alternative, based on above-average reading comprehension. This belief fosters a sense of mastery in female students that they do not experience when exposed to mathematics, even if they perform well in this area. Due to lower-than-average reading comprehension skills and a reluctance to engage in reading activities, male students may be more often deprived of this choice. The limited options may contribute to their attachment to mathematics. While female students have the opportunity to move into various fields of employment and education that require language skills, many male students do not.

Attitudes towards mathematics are formed throughout compulsory education and their effects are particularly evident at university. Given that, on average, both genders dislike mathematics, males are more likely to take the secondary school leaving examination in this subject, and this decision opens up opportunities for them to study maths-related majors, such as engineering and technology. As evidenced by their lower presence among students and graduates in math-intensive fields, women are consistently and significantly less likely to use this gateway. The question, therefore, remains open: Why do some mathematically talented women shift their interests to other fields?

The modern world is changing too rapidly to make reliable predictions about the dynamics of the educational attainment structure of men and women. The effects of the gender gap in tertiary education are already visible. The predominance of women in tertiary education is reflected in many aspects of society. For example, the rules of pairing in terms of educational level have changed. Traditionally, people with the same or similar levels of education form relationships, with men in older age groups being better educated. The desire to form a relationship with a person with a similar level of education was due to elementary socialisation mechanisms that emphasise intellectual proximity, shared interests and tastes, and a similar mentality and social position – and these elements are common to certain educational categories. The gender gap in higher education is gradually reversing the previous educational asymmetry in favour of women. The trend of decreasing educational homogamy among those with tertiary education has been observed in Poland since the 1970s (Domański and Przybysz, 2009).

This leads to a new type of relationship in which the woman – better educated than her partner – contributes more than half of the household budget (Klesment and Van Bavel, 2015). This change, together with women's increasing economic independence, is associated with a shift in roles within households. Women with higher education make a larger and more stable contribution to the family budget than those with less education, and this factor becomes an important argument in terms of sharing household responsibilities and the right to pursue a career on an equal footing. In that sense, although educational advancement has not completely levelled the playing field for both genders in the labour market, not to mention in terms of pay, women have been able to break out of traditional hierarchical arrangements in which men were primarily economically active and took responsibility for the economic well-being of the family. Increased empowerment of women goes hand in hand with the expectation of greater partnership in the family, the introduction of a fair division of responsibilities, and equal work opportunities. Financial independence, underpinned by education, became an important factor in women's empowerment, enabling them to live their lives according to their individual scenarios. This family model and type of relationship is becoming more common and is preferred by women with higher education. Changes in reproductive patterns – postponing motherhood and reducing the number of children in families – can also promote women's education and self-fulfilment. The reduction of responsibilities in this area and of the time investment and commitment in child rearing creates space for the fulfilment of self-development aspirations, also in the areas of education and work.

Changes in the labour market may perpetuate differences in educational choices between women and men. Deregulation of forms of employment, which introduces a high degree of uncertainty into the careers of younger generations, may become a factor encouraging women to invest more in education. Studies show that people with lower levels of education are more likely to be employed on non-standard contracts, which can be a source of anxiety for them due to job instability. Research shows that non-standard forms of employment double the risk of unemployment and reduce the chances of obtaining an open-ended contract in subsequent years (Kiersztyn, 2017). Skipping formal tertiary education is associated with the opportunity to use one's own resources and thus greater freedom in the labour market, but it also increases the risk of failure and the need to face the daily anxiety of job instability. The latter seems to be better managed by men than by women.

Educational choices combine issues of personal autonomy and individual ambition with intellectual capacity, which are intertwined with social, economic, and institutional mechanisms. Due to limited access to empirical material and the multifaceted nature of schooling decisions, some of the more specific questions related to gender differences in educational attainment still remain without answers. One of the most intriguing questions is the relationship between various neurological, cognitive, and hormonal characteristics and school choice. This seems particularly relevant when the central explanatory variable is gender, which combines biological and social dimensions. I leave it to researchers with the appropriate methodological and substantive background to consider the role of these aspects. Analyses carried out in recent years suggest that there is considerable scope for exploring these relationships and that educational decisions may be an indirect effect of the combined influence of social and certain biological aspects. For example, there is a need to clarify the different rates of development of certain non-cognitive characteristics of male and female pupils observed in the lower grades. What is the source of the advantage of girls in pro-social and verbal skills already at the beginning of the educational system? Is their verbal competence – higher in all countries covered by international research programmes – the result of neurological or cognitive factors? Is women's tendency to choose social orientations related to their greater responsiveness to a variety of social situations, empathy, and better performance in theory of mind tests? Is the tendency of boys to compete, to take risks, and to be less afraid of being criticised the result of their biological inferiority in social skills? The development of research methodologies and the increasing access to specialised equipment for learning about human neurobiological mechanisms offer hope for finding answers to these questions. Extending the social science paradigm of man as a social being to include a biological factor may be a further step towards discovering individual differences in educational choices.

There is another limitation to the scope of this publication in that I have focused on gender differences, not within gender. It would be worthwhile to conduct research on the educational choices of such groups. Such analyses could contribute to a better understanding of how women making other educational choices differ and in what dimensions they are similar, e.g., engineering students versus language students, or education students versus those choosing robotics. In addition to their level of mathematical ability, do they differ in terms of personality, social status, and gender identity? What are their economic aspirations and career plans? Answers to these questions could help to identify psychological and social factors that contribute to the attrition of mathematically talented women at different stages of education.

The issue of discrepancies in the subjective assessment of the mathematical abilities of male and female students deserves the attention of researchers and educational policy-makers as well as the agents of socialisation. Mathematical competency is not the only component that defines the category of *homo mathematicus*, and identifying the causes of this phenomenon can prevent the withdrawal of talented women from this field. Such interventions need to be taken as early as possible when their attitudes towards mathematics, fears, or self-stereotypes about their abilities are being formed. Well-thought-out measures would introduce women to the peculiarities of professional roles, environments, and working styles in knowledge-intensive fields, and would expose future programming and engineering male students to the presence of the opposite gender in equivalent roles. In this way, mathematically talented women will make their educational choices not based on fear of failure, insecurity about their own competence, and discomfort at the prospect of being in the minority but on the basis of ability and commitment. However, an effective tool for the inclusion of women is not episodic affirmative action, but the presence of supportive role models in the immediate environment of young females. It can be assumed that the biographies of current female students of engineering, navigational science or robotics featured people who, in various ways, allayed their fears about choosing a mathematical field of study and drew an optimistic career scenario for them.

The conclusions of this analysis suggest that attention should also be paid to the functioning of boys and men in the educational environment. They are the ones who are more likely to have behavioural problems, who adapt less well to the social norms of the school, and who are less likely to conform to the expected model of a "good student" (questioning of rules in educational institutions, lower grades, lower reading scores, more frequent behavioural problems, and a higher risk of repeating a year or dropping out of the education system). It cannot be excluded that changes in family structure, including an increase in the number of single parents, affect boys more negatively than girls. Such an effect has been observed in many countries and is probably also the case in Poland. Skilfully implemented intervention programmes can prevent some of the problems faced by students belonging to these educational risk groups.

Further exploration of the reasons for the different functioning of boys and girls in education environment would provide the opportunity to make changes that would create favourable conditions for the development of all students, regardless of gender. The same imperative should guide programmes to increase the retention of mathematically talented female students and to reduce the social barriers that discourage them from pursuing careers in mathematics--related fieldsto, as well as making it easier for boys to function in the education system. Research on this issue (some of which is presented in this book) suggests that educational policy tools already exist to support the development of both male and female students and to facilitate their functioning in school. Now it is time to use them.

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Descriptions of data sets used

The **TIMSS** (Trends in International Mathematics and Science Study) and **PIRLS** (Progress in International Reading Literacy Study) studies are cyclical research projects conducted in dozens of countries, involving students after the fourth year of schooling. TIMSS examines skills in mathematical reasoning and science. In addition to the skills tasks, students as well as parents, teachers, and school management, complete questionnaires on attitudes and learning conditions. The PIRLS survey addresses reading comprehension skills in relation to literary and informational material. The sampling is random and involves selecting schools and within them selecting students for the survey. Further information on the study: PIRLS (tinyurl.com/5es45a3f) and TIMSS (tinyurl.com/yywadru4).

PISA (Programme for International Student Assessment) is a periodic study of 15-year-olds' skills in mathematics, reading, and science. The study in each country is conducted on a representative sample of several thousand students drawn from schools of different types. In Poland, between 2003 and 2018, the study covered almost exclusively lower secondary school students (in 2018, these were mainly students in the final year of that school). Details of the study are available on the website: oecd.org/pisa.

The study "**Od szkoły do pracy: indywidualne i instytucjonalne wyznaczniki kształtowania się ścieżek karier edukacyjno-zawodowych młodych Polaków**" [From school to work: individual and institutional determinants of the formation of educational and professional career paths of young Poles] was carried out in 2014 on a sample of 5923 people born between 1992 and 1993. Its aim was to trace their professional and educational choices. Data was collected using face-to-face and online interview methods. The methodology has been described in detail in: Domański at al. (2015; 2016). Dataset provided courtesy of Prof. Henryk Domański.

The European Social Survey is an international research project aimed at observing social change in selected areas such as health, views on democracy, and family life. Most European countries (mainly EU Member States) and a few from outside the continent take part in the surveys, which are conducted every two years. Survey participants complete standardised questionnaires (in paper or digital form). Data and methodological details are available at: ess.ifispan.pl; europeansocialsurvey.org.

Annexe

Data and methods of analysis

The tables for the analysis that use the logistic regression method contain the values of the odds ratios obtained from the logistic regression model. The odds refer to the ratio of the probability of the occurrence of a certain phenomenon to its non-occurrence – e.g., obtaining a secondary school leaving certificate or higher education degree as opposed to not obtaining one. The odds ratio, on the other hand, refers to the comparison of the two groups and is expressed as the ratio of the odds of the phenomenon being studied occurring in one group to the odds of it occurring in the other. An odds ratio value greater than 1 means that the odds of an event occurring in one group are greater than in the other (comparison), and if it falls below 1, the relationship is reversed.

Linear regression makes it possible to predict the value of an explained variable as a function of the values of explanatory variables. In simple linear regression, two parameters are determined. The first (constant) indicates the average value of the explained variable when the values of the explanatory variables are 0. The slope (b), on the other hand, indicates how much the explained variable increases when the value of the explanatory variable increases by one unit.

In the vast majority of linear regression models carried out in the various PISA rounds, the variables that explained the phenomena under investigation (e.g., the level of self-assessed mathematical skills) were the scores obtained by students in a mathematical reasoning test or a reading comprehension test. These scores were obtained using a scaling procedure called Item Response Theory (IRT). Unlike the simple adding up of scores obtained in an aptitude test, this method estimates the score obtained by a student taking into account both his or her level of ability and the difficulty of the test. The same method was used to scale the attitudinal and behavioural variables of the students who participated in the survey. Detailed information describing the scaling procedure can be found in the following publications: *PISA Technical Report 2015 and PISA Technical Report 2018*. Due to the complexity of the sample, replication weights were used to estimate random errors in the analyses, in accordance with the analytical recommendations of the PISA survey organisers.

The scores obtained from the mathematical reasoning and reading comprehension tests in TIMSS and PIRLS were scaled in a similar way. Students' responses were transformed into an IRT-based scale and the "probability scores" obtained in the aptitude test were rearranged. Each male and female student was assigned a number (usually five) of probabilistic scores (reflecting ability), taking into account responses to all questions in the test. Descriptions of the scaling procedures are available at PIRLS (bit.ly/43k5zxF) and TIMSS (bit.ly/3IUhbzc) websites.

Table A.1

The table presents the odds ratio values obtained in the logistic regression model, describing the relationship between achieved education level, social position of a student and gender from a generational perspective in Poland. The explained variable was coded either as zero or one. The value 0 was assigned to those who completed primary education, lower secondary education, basic vocational education, or secondary education without a school leaving certificate. The value 1 was assigned to those who had completed secondary education or tertiary education. Persons aged 26 and more were included in the analysis. In addition to the birth factor, divided into five subcategories (1911–1949, 1950–1959, 1960–1969, 1970–1979, 1980–2006), the models included the mother's educational attainment and the father's occupation when the respondent was 14 years. The former variable has four categories: tertiary education, secondary education (*matura* as a reference category), basic vocational education, and lower- than basic vocational education. The father's occupation variable is divided into the following categories: professionals and senior administration staff, middle-level staff and salespeople, skilled workers (reference category), unskilled workers and farmers. Data has been taken from the combined 2002–2020 European Social Survey dataset.

TABLE A.1. ODDS RATIO VALUES FOR OBTAINING AT LEAST A SECONDARY SCHOOL LEAVING CERTIFICATE [*MATURA*] – LOGISTIC REGRESSION (N = 5194, STANDARD ERRORS IN BRACKETS)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Women	1.52 (0.08)*	1.65 (0.09)*	1.69 (0.24)*	1.72 (0.11)*	1.79 (0.22)*	1.81 (0.11)*	1.76 (0.26)
Age category (ref.: 1970–1979)							
1911–1949		0.35 (0.03)*	0.51 (0.07)*	0.47 (0.05)*	0.47 (0.05)*	0.77 (0.09)*	0.77 (0.09)*
1950–1959		0.49 (0.04)*	0.50 (0.07)*	0.56 (0.06)*	0.56 (0.06)*	0.94 (0.10)	0.94 (0.10)
1960–1969		0.59 (0.06)*	0.51 (0.07)*	0.66 (0.07)*	0.66 (0.07)*	0.87 (0.09)	0.87 (0.09)
1980–2006		1.17 (0.10)	1.13 (0.14)*	1.06 (0.106)*	1.06 (0.12)	0.77 (0.07)*	0.77 (0.07)*
Interaction: women × cohort							
1911–1949			0.56 (0.11)*				
1950–1959			0.98 (0.19)				
1960–1969			1.32 (0.27)				
1980–2006			1.07 (0.18)				
Father's occupation (ref.: skilled workers)							
professionals and senior administration staff				3.63 (0.57)*	4.37 (0.94)*		
middle-level and sales staff				1.96 (0.22)*	2.41 (0.38)*		
unskilled workers				0.61 (0.05)*	0.59 (0.07)*		
farmers				0.38 (0.03)*	0.36 (0.05)*		

Interaction: women × father's occupation							
professionals and senior administration staff					0.65 (0.2)		
middle-level and sales staff					0.64 (0.14)*		
unskilled workers					1.04 (0.18)		
farmers					1.10 (0.20)		
Mother's education (ref.: secondary (*matura*))							
higher						1.29 (0.16)	0.14 (0.02)*
basic vocational						0.31 (0.03)*	0.29 (0.04)*
primary						0.77 (0.09)*	1.37 (0.25)
Interaction: women × mother's education							
higher							0.81 (0.21)
basic vocational							1.04 (0.18)
primary							1.09 (0.21)
Odds in the reference category	0.65	0.83	0.83	0.99	0.98	2.27	2.29
Logarithm of likelihood	-3537	-3408	-3398	-2711	-2707	-2931	-2931

* $p < 0.05$.

Table A.2

The table shows the odds ratio values for enrolment in higher education that were obtained from the logistic regression model. The study population is composed of individuals born in 1993 and 1994 who graduated from a technical or general secondary school and successfully passed the secondary school leaving (*matura*) examination. The explanatory variable is binary: a value of 1 indicates entry to university (not necessarily the completion of studies) and a value of 0 indicates education completion at an earlier stage.

The explained variables are: gender (value 1 assigned to women, 0 to men), type of upper secondary school (a zero-one variable, where 1 stands for general secondary school and 0 for technical and specialised secondary school), Polish language and mathematics final exams results (based on respondents' declarations). Social status variables were also included: mother's education, divided into three categories, and father's occupation (in the form of the six main categories of the Erikson-Goldthorpe-Portocarero occupational class schema). The reference category for mother's education was secondary education (*matura*), while for the father's occupation, it was unskilled worker.

The data used comes from the study entitled From school to work: indywidualne i instytucjonalne wyznaczniki kształtowania się ścieżek karier edukacyjno-zawodowych młodych Polaków [*From school to work: individual and institutional determinants of the formation of educational and professional career paths of young Poles*] carried out under the direction of Prof. Henryk Domański.

Model one takes gender into account, model two the type of school, and model three the interaction of these two variables. Models four and five include indicators of social status – father's occupation and mother's education – in addition to gender and school.

TABLE A.2. ODDS RATIO VALUES OF ENTERING HIGHER EDUCATION FOR 1993 AND 1994 HIGH SCHOOL GRADUATES – LOGISTIC REGRESSION (STANDARD ERRORS IN PARENTHESES)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Women	1.19 (0.10)*		0.72 (0.08)*	0.90 (0.11)	1.2 (0.13)
General secondary school (ref.: technical secondary school)		6.42 (0.64)	6.93 (0.93)*	6.92 (0.68)*	3.77 (0.43)*
Interaction: women × general secondary school			1.31 (0.24)		
result in Polish *matura* exam					1.14 (0.07)*
result in maths *matura* exam					3.83 (0.25)*
Father's occupation (ref.: unskilled worker)					
higher-grade manager, professional				2.64 (0.55)*	1.45 (0.37)
non-manual employee				1.94 (0.32)*	1.36 (0.26)
proprietor				1.38 (0.23)	1.28 (0.24)
skilled manual worker				0.9 (0.11)	0.83 (0.12)
farmer or smallholder				0.84 (0.11)	0.76 (0.13)
Mother's education (ref.: secondary [*matura*])					
higher					1.86 (0.32)*
primary and basic vocational					0.6 (0.07)*
Odds in the reference category	3.92	1.62	1.29	1.10	3.18
Logarithm of likelihood	-1817	-1590	-1875	-1719	-1247

* $p < 0.05$.

Table A.3

The table shows the coefficients of a linear regression. The explained variable is an index of attitudes towards school, constructed from questions asked of students in the 2018 PISA survey. It consists of three statements expressed on an ordinal scale: "Trying hard at school will help me get a good job"; "Trying hard at school will help me get into a good college"; and "Trying hard at school is important". These were scaled using IRT. A higher value indicates a more positive attitude towards education compared to the average value. The same method brought a variable determining the mathematical reasoning and reading test scores (*PISA 2018: Technical Report*).

The social position of a student is expressed in terms of the highest parents' socio-economic index (HISEI). This variable is built on the International Socio-Economic Index of Occupational Status (ISEI). Educational aspirations is a zero-one variable: a value of 1 refers to the student's declaration that they will complete a given level of education. The variables used in the analyses (apart from the one on educational aspirations) have been standardised – the mean value is 0 and the standard deviation is 1.

In the first model, attitudes towards school are explained by a zero-one coded variable indicating a student's gender (a value of 1 was assigned to girls), while in the next model, the student's performance in mathematical reasoning and reading tests and the student's social status are added. The last model takes into account educational aspirations.

TABLE A.3. ATTITUDES TOWARD SCHOOL – LINEAR REGRESSION (N = 5192, STANDARD ERRORS IN PARENTHESES)

	Model 1	Model 2	Model 3
Girls	0.15 (0.02)*	0.12 (0.03)*	0.09 (0.03)*
mathematical reasoning test score		-0.01 (0.03)	-0.03 (0.03)
reading comprehension test score		0.06 (0.03)	0.03 (0.033)
social status		0.03 (0.01)*	-0.02 (0.01)
educational aspirations			0.24 (0.03)*
Constant	-0.08	-0.05	-0.18
r^2	0.007	0.010	0.022

* $p < 0.05$.

Table A.4

The values of the linear regression coefficients are shown in the table. The analyses are based on data from PISA 2018. The explained variable is the time (expressed in minutes) spent studying after school on the day before the survey.

The first model included gender coded zero–one (value 1 assigned to women) and the second model also that the student wished to study at an HEI. This variable, which indicates educational aspirations, was coded as zero-one, with a value of 1 indicating that the student wished to study at an HEI. In addition to gender, subsequent analyses included students' SES, measured by parental occupation (HISEI) and test scores (model 3), and attitudes towards school (statements that were used to create this scale are given in the description of table A.3) and intellectual development (growth mindset) (model 4). The last variable refers to a statement about the possibility of developing one's own intelligence. In the model, this variable was included as a zero-one variable: values indicating the possibility of developing one's own intelligence are coded as 1. The last model also includes an additional variable referring to the frequency of playing video games (in the form of a zero-one variable: 1 indicates playing daily or almost daily). Details on the content of the questions are available in *PISA 2018: Technical Report*.

The variables are standardized, except for the zero-one coding. They have a mean of 0 and a standard deviation of 1.

TABLE A.4. TIME SPENT ON LEARNING AFTER SCHOOL – LINEAR REGRESSION (N = 3424, STANDARD ERRORS IN PARENTHESES)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Girls	0.31 (0.03)*	0.3 (0.03)*	0.34 (0.03)*	0.3 (0.03)*	0.24 (0.04)*
entering a university		0.08 (0.03)*		0.15 (0.04)*	0.18 (0.04)*
social status			0.08 (0.15)*	0.06 (0.05)*	0.06 (0.02)*
mathematical reasoning test score			0.01 (0.03)	0.01 (0.026)	-0.02 (0.03)
reading comprehension test score			-0.12 (0.03)*	-0.15 (0.03)*	-0.17 (0.03)*
attitudes towards school				0.12 (0.02)*	0.12 (0.02)*
growth mindset				0.04 (0.03)	
playing video games (1 = often)					-0.15 (0.05)*
Constant	-0.23	-0.27	-0.23	-0.31	-0.18
r^2	0.038	0.03	0.05	0.072	0.072

*$p < 0.05$.

Table A.5

The table shows the odds ratio values and the mean scores obtained in the 2012 to 2016 lower secondary school leaving examinations in mathematics and Polish. The values do not allow a direct comparison of the scores between the different years but illustrate the gender differences in a given year.

The table shows the mean calculated on the basis of the standardised examination results (mean 100, standard deviation 15) and the odds ratio on each part of the score distribution. Values above 1 indicate that female students were more likely to score in the range, and below zero male students were more likely to score in the range.

TABLE A.5. MEAN SCORES AND ODDS RATIO FOR LOWER SECONDARY SCHOOL LEAVING EXAM IN MATHEMATICS AND POLISH

Year	**Mean score**		**Odds ratio (girls to boys)***			
	Girls	**Boys**	**≤ 25%**	**> 50%**	**> 75%**	**≥ 99%**
Mathematics						
2012	99.3	100.6	1.19	1.13	0.89	0.86
2014	98.3	101.1	1.33	1.23	0.85	0.75
2016	99.7	100.3	1.11	1.04	0.97	0.71
Polish						
2012	103.3	96.7	0.50	0.52	1.97	2.60
2014	101.6	94.8	0.53	0.52	2.00	2.61
2016	103.5	96.6	0.49	0.48	1.28	3.39

Source: Examination results made available by Zespół Pomiaru Dydaktycznego [The Educational Research Institute] (IBE) and downloaded using tools developed by Mateusz Żółtak (Szaleniec et al., 2015).

Table A.6

The table shows the values of the odds ratio of scores within the specified range and the mean scores obtained in the standard-level mathematics *matura* exam between 2012 and 2016. The values do not allow for direct comparison of results from one to another age groups, but they illustrate the differences between the sexes in a given year.

The table shows the mean calculated on the basis of the standardised exam results (mean 100, standard deviation 15) and the odds ratio on each part of the score distribution. Values above one indicate an advantage for female students and below – an advantage for male students.

TABLE A.6. MEAN SCORES AND ODDS RATIO FOR THE RESULTS OF STANDARD LEVEL MATHEMATICS SECONDARY SCHOOL LEAVING EXAM [*MATURA*] (ONLY STUDENTS WHO SAT THE EXAM AT THIS LEVEL)

Year	Mean		Odds ratio (girls to boys)			
	Girls	Boys	⩽ 25%	> 50%	> 75%	⩾ 99%
2012	100.72	98.97	0.94	0.81	0.69	1.43
2014*	101.01	98.45	0.82	0.74	1.47	1.83
2016	101.17	98.09	0.79	0.69	1.61	1.59

Source: Examination results made available by The Educational Research Institute (IBE) School Achievement Measurement Team and downloaded using tools developed by Mateusz Żółtak (Szaleniec et al., 2015)

* The new version of the standard level secondary school leaving (*matura*) exam.

Table A.7

The table shows the odds ratio values for sitting the *matura* exam in a given subject at the advanced level in 2020 and 2022. The values represent the ratio of those who took the exam in a particular subject to those who did not. Data for the table is taken from the secondary school leaving exams reports by Centralna Komisja Egzaminacyjna [The Central Examination Board] (cke.gov.pl) for 2020 and 2022.

Values above than one indicate that boys were more likely to choose a particular subject and values below one that girls had a higher probability of choosing a particular subject.

TABLE A.7. ODDS RATIO FOR TAKING THE SECONDARY SCHOOL LEAVING [*MATURA*] EXAM IN A GIVEN SUBJECT AT THE ADVANCED LEVEL IN 2020 AND 2022 (CONFIDENCE INTERVALS IN SQUARE BRACKETS)

	2020		2022	
Mathematics	2.34	[2.31; 2.39]	2.25	[2.22; 2.29]
Polish	0.27	[0.27; 0.28]	0.25	[0.2; 0.29]
Biology	0.31	[0.31; 0.32]	0.3	[0.3; 0.31]
Physics	4.43	[4.29; 4.58]	4.25	[4; 4.4]
Computer science	12.68	[11.75; 13.62]	11.55	[10.75; 12.35]
Chemistry	0.38	[0.37; 0.4]	0.36	[0.35; 0.37]

Table A.8

The table shows the results of a linear regression where the explained variable is students' self-assessment of their mathematical skills. This variable was created based on a series of statements referred to by third-grade students in the TIMSS 2011 study: "I usually do well in mathematics"; "Mathematics is harder for me than for many of my classmates"; "I am just not good in mathematics"; "I learn things quickly in mathematics"; "I am good at solving problem tasks"; "My teacher tells me I am good at mathematics"; "Mathematics is harder for me than any other subject" (Konarzewski, 2012; Martin and Mullins, 2013). The study participants provided responses on a scale from "strongly agree" to "strongly disagree".

Gender as a zero-one coded variable (with a value of 1 representing girls) and the scores obtained in the mathematics aptitude test are the explained variables. The first model takes into account only gender, the second takes into account maths test score, and the next model takes into account both of these variables. The fourth model deals with the interaction of gender and mathematics test score, and the last model also considers the influence of the variable expressing a male or female student's attitude to learning mathematics (whether and to what extent the student likes this subject). This scale consists of answers to the following questions: "I enjoy learning mathematics"; "I wish I did not have to study mathematics"; "Mathematics is boring"; "I learn many interesting things in mathematics"; "I like mathematics"; "It is important to do well in mathematics". This variable, like the self-confidence measure, was scaled using the IRT method.

The score on the mathematics test and the variable "attitude towards mathematics" had a mean of 0 and a standard deviation of 1. Analyses were performed controlling for students' age (mean age was 9.9 years) and SES as defined in the TIMSS 2011 survey (social status includes parental education, occupational category, employment status, and household furnishings). For more on the research method and scaling, see Martin and Mullis (2012).

TABLE A.8. SELF-CONFIDENCE OF THIRD GRADERS' MATHEMATICAL SKILLS IN THE TIMSS 2011 – LINEAR REGRESSION (N = 4962)

	Model 1	Model 2	Model 3	Model 4	Model 5
girls	-0.46 (0.07)*		-0.32 (0.07)*	-0.34 (0.07)*	-0.34 (0.57)*
mathematical reasoning test scores		0.65 (0.04)*	0.62 (0.03)*	0.71 (0.04)*	0.44 (0.03)*
Interaction: female students × mathematics test scores				-0.21 (0.06)*	
attitude towards mathematics					1.13 (0.03)
Constant	10.74	8.84	10.42	10.4	9.99
r^2	0.01	0.04	0.11	0.12	0.41

* $p < 0.05$.

Table A.9

The table shows the results of a linear regression explaining the self-confidence of the third-graders' reading skills surveyed in the 2011 PIRLS. Children assessed their own skills by responding to the statements: "I usually do well in reading"; "Reading is easy for me"; "Reading is harder for me than for many of my classmates"; "If a book is interesting, I don't care how hard it is to read"; "I have trouble reading stories with difficult words"; "My teacher tells me I am a good reader"; "Reading is harder for me than any other subject". The results were transformed using a scaling method based on test cue theory (for a detailed description of the methodology see: Martin and Mullins, 2012).

In the first model, the level of self-assessed reading skill is estimated by the student's gender, expressed as a zero or one (a value of 1 was assigned to girls). The next model explains self-assessment through reading test score, and the third model considers both variables. Model 4 estimates the interaction of gender and reading test score, and the last model takes into account the "I like reading" and "motivation for read" scales in addition to gender and test scores (the statements used to construct these scales are presented in the description of tables A.10.1 and A.10.2). The variables used in the analyses were standardised – mean value is 0 and standard deviation is 1. Analyses were controlled for student social status (the scale included parental education, occupational category, employment status, and home furnishings).

TABLE A.9. LINEAR REGRESSION COEFFICIENTS OF THIRD GRADERS' SELF-ASSESSED READING SKILLS IN PIRLS 2011 (N = 4962, STANDARD ERRORS IN PARENTHESES)

	Model 1	Model 2	Model 3	Model 4	Model 5
Girls	0.42 (0.06)*		0.28 (0.05)*	0.27 (0.05)*	-0.11 (0.05)
reading literacy test score		0.93 (0.03)*	0.91 (0.03)*	0.92 (0.04)*	0.81 (0.03)*
Interaction: Female students × reading test score				-0.03 (0.07)	
enjoyment of reading					0.18 (0.02)*
attitudes towards reading					0.24 (0.02)*
Constant	7.36	9.97	9.81	9.81	6.23
r^2	0.06	0.19	0.19	0.2	0.31

* $p < 0.05$.

Table A.10.1

The table shows the results of a t-test comparing the mean obtained by boys and girls on the "Motivation to read" scale obtained in the PIRLS 2011 study. The scale consisted of the following statements: "I like to read things that make me think"; "It is important to be a good reader"; "My parents like it when I read"; "I learn a lot from reading"; "I need to read well for my future"; "I like it when a book helps me imagine other worlds". A higher index value indicates greater motivation to read (for a detailed description of the methodology see: Martin and Mullins, 2012).

TABLE A.10.1. THE RESULTS OF THE T-TEST – SCALE: "MOTIVATION TO READ" (PIRLS 2011)*

	N	Mean	Standard deviation	t	Df
girls	2525	10.26	0.04	12.61	4897
boys	2374	9.54	0.03		

* Gender differences are significant at $p < 0.05$.

Table A.10.2

The table shows the results of a t-test comparing the mean obtained by boys and girls on the "I like reading" scale, derived from the PIRLS 2011 survey. The scale included the following statements: "I read only if I have to"; "I like talking about what I read with other people"; "I would be happy if someone gave me a book as a present"; "I think reading is boring"; "I would like to have more time for reading"; "I enjoy reading". A higher index value indicates that the student feels more pleasure from reading (for a detailed description of the methodology see: Martin and Mullins, 2012).

TABLE A.10.2. THE RESULTS OF THE T-TEST – SCALE: "ENJOYMENT OF READING" (PIRLS 2011)*

	N	Mean	Standard deviation	t	Df
girls	2553	10.4	0.04	21.54	4945
boys	2394	9.11	0.03		

* Gender differences are significant at $p < 0.05$.

Table A.11

The table shows the results of a linear regression explaining the fourth graders' mathematical confidence based on the TIMSS 2019 survey. In the survey, students were asked to respond to the following questions related to their attitudes to mathematics: "I usually do well in mathematics"; "Mathematics is harder for me than for many of my classmates"; "I am just not good at mathematics"; "I learn things quickly in mathematics"; "My teacher tells me I am good at mathematics"; "Mathematics is harder for me than any other subject"; "Mathematics makes me confused"; "Mathematics makes me nervous"; "I am good at working out difficult mathematics problems". The students' answers were transformed in the procedure of scaling the answers to the test question (IRT), (*TIMSS 2019. Creating and Interpreting the TIMSS 2019 Contextual Questionnaire Scales*). Higher values indicate greater confidence in one's mathematical skills.

In the survey, students were also asked to respond to questions related to their attitudes to mathematics: "I enjoy learning mathematics"; "I wish I did not have to study mathematics"; "Mathematics is boring"; "I learn many interesting things in mathematics"; "I like mathematics"; "I like any schoolwork that involves numbers"; "I like to solve mathematics problems"; "I look forward to mathematics lessons"; "Mathematics is one of my favourite subjects". These statements form a scale of "attitudes towards mathematics" (*TIMSS 2019. Creating and Interpreting the TIMSS 2019 Contextual Questionnaire Scales*).

The analyses in the table have been conducted controlling for the age and social status of the students. The latter variable is a composite scale, which includes the number of books in the household, the educational level of the parents, access to the Internet, and having a private bedroom. The variables used in the analyses had a mean of 0 and a standard deviation of 1. In the case of gender, the variable was coded as zero-one, and girls were assigned a value of 1. The first model includes gender, the next only includes the mathematics test score, and the third includes both variables. The fourth model considers the interaction of gender and mathematics score, and the fifth model includes attitudes to mathematics as an additional variable.

TABLE A.11. LINEAR REGRESSION COEFFICIENTS OF FOURTH GRADERS' SELF-CONFIDENCE IN THEIR MATHEMATICAL SKILLS BASED ON THE TIMSS 2019 (N = 4484, STANDARD ERRORS IN PARENTHESES)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
girls	-0.45 (0.06)*		-0.32 (0.06)*	-0.31 (0.06)*	-0.29 (0.04)*
mathematical reasoning test scores		0.82 (0.03)*	0.81 (0.03)*	0.88 (0.03)	0.57 (0.02)
Interaction: female students × mathematical reasoning test scores				-0.17 (0.02)*	
attitude to mathematics					0.98 (0.03)*
Constant	9.80	9.54	9.70	9.70	9.69
r^2	0.06	0.21	0.22	0.21	0.48

* $p < 0.05$.

Table A.12

The table shows the coefficients obtained in the linear regression model. The explained variable is the perceptions of the fourth-graders participating in the PIRLS 2016 survey about their own reading skills. The assessment of the self-confidence was determined on the basis of the following statements: "Reading is easy for me"; "I usually do well in reading"; "Reading is harder for me than any other subject"; "Reading is harder for me than for many of my classmates"; "I am just not good at reading"; "I have trouble reading stories with difficult words". The responses to these statements were transformed into a scale measuring reading self-confidence (*PIRLS 2016. Creating and Interpreting the PIRLS 2016 Contextual Questionnaire Scales*). Higher scores indicate better self-assessment of reading skills.

Model 1 includes the value of the gender coefficient. Model 2 includes the estimated value of the reading score. Model 3 contains the two variables. Model 4 includes the interaction between gender and reading test score. The reading comprehension test score had a mean of 0 and a standard deviation of 1. Gender is coded as zero-one, with a value of 1 assigned to girls.

TABLE A.12. READING SELF-CONFIDENCE OF FOURTH GRADERS IN THE 2016 PIRLS SURVEY – LINEAR REGRESSION (N = 4413, STANDARD ERRORS IN PARENTHESES)

	Model 1	**Model 2**	**Model 3**	**Model 4**
girls	0.27 (0.08)*		0.07 (0.08)	0.06 (0.07)
reading comprehension test score		0.83 (0.03)*	0.83 (0.03)*	0.85 (0.05)*
Interaction: girls × reading comprehension test score				-0.04 (0.06)
Constant	10.55	10.73	10.69	10.7
r^2	0.00	0.17	0.16	0.16

* $p < 0.05$.

Table A.13.1

The table shows the results of the t-test comparing the mean scores on the scale of student engagement in reading lessons and the scores obtained by girls and boys. The respondents could describe their attitude towards Polish language teaching by referring to the following statements: “My teacher does a variety of things to help us learn”; “I know what my teacher expects me to do”; “My teacher tells me how to do better when I make a mistake”; “My teacher gives me interesting things to read”; “My teacher is easy to understand”; “My teacher lets me show what I have learned”; “I am interested in what my teacher says”; “My teacher encourages me to say what I think about what I have read”; “I like what I read about in school”. These statements were scaled using the IRT method (*PIRLS 2016. Creating and Interpreting the PIRLS 2016 Contextual Questionnaire Scales*).

TABLE A.13.1. T-TEST: ENGAGEMENT IN READING LESSONS OF FOURTH GRADE STUDENTS (PIRLS 2016)

	N	Mean	Standard deviation	t	Df
girls	2211	9.55	0.03	5.81	4396
boys	2187	9.22	0.04		

* Mean differences are significant at $p < 0.05$.

Table A.13.2

The table shows the results of a t-test which compares the mean value on the enjoyment of reading scale obtained by girls and boys. The respondents related to the following statements: “I like it when a book helps me imagine other worlds”; “I learn a lot from reading”; “I like to read things that make me think”; “I enjoy reading”; “I like talking about what I read with other people”; “I would be happy if someone gave me a book as a present”; “I would like to have more time for reading”; “I think reading is boring”.

TABLE A.13.2. T-TEST: ENJOYMENT OF READING OF FOURTH GRADE STUDENTS (PIRLS 2016)

	N	Mean	Standard deviation	t	Df
girls	2212	9.85	0.04	13.81	4395
boys	2185	9.05	0.04		

* Mean differences are significant at $p < 0.05$.

Table A.14

The table shows the coefficients obtained in a linear regression model conducted on data from PISA 2012. The self-concept of students' mathematical skills was determined based on the following statements: "I am just not good at mathematics"; "I get good grades in mathematics"; "I learn mathematics quickly"; "I have always believed that mathematics is one of my best subjects"; "In my mathematics class, I understand even the most difficult work". Higher values indicate a greater sense of mathematical competency.

In addition to gender, instrumental motivation to learn mathematics was included as an explanatory variable in the analyses. In PISA 2012, it was assessed using the following statements: "Making an effort in mathematics is worth it because it will help me in the work that I want to do later on"; "Learning mathematics is worthwhile for me because it will improve my career"; "Mathematics is an important subject for me because I need it for what I want to study later on"; "I will learn many things in mathematics that will help me get a job".

In PISA 2012, male and female students were asked about their educational and career plans regarding mathematics, relating them to decisions concerning science or Polish. They could choose one statement from each of the following pairs: "I intend to take additional mathematics courses after school finishes / I intend to take additional Polish courses after school finishes"; "I plan on majoring in a subject that requires mathematics skills / science skills"; "I am willing to study harder in my mathematics classes than is required / I am willing to study harder in my Polish classes than is required"; "I plan on [having] as many mathematics / science classes as I can during my education"; "I am planning on pursuing a career that involves a lot of mathematics / science" (*PISA 2012: Technical Report*).

The three items above were developed using the scaling procedure for the IRT test question responses (*PISA 2012: Technical Report*). Like math test scores they have a mean with a value of 0 and a standard deviation of 1. The analyses were controlled for social status including the students' economic, social, and cultural capital.

Model 1 takes into account gender. Model 2 takes into account mathematical reasoning test score. Model 3 takes into account the two variables. Model 4 includes the interaction of gender and mathematics test score. Model 5 estimates the interaction between the value of instrumental motivation to learn mathematics and gender. Model 6 estimates the effect of students' educational and vocational plans related to mathematics.

TABLE A.14. MATHEMATICAL SELF-CONCEPT OF 15-YEAR-OLDS WHO TOOK PART IN PISA 2012 – LINEAR REGRESSION (N = 4607, STANDARD ERRORS IN PARENTHESES)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
girls	-0.21 (0.04)*		-0.17 (0.03)*	-0.17 (0.03)*	-0.13 (0.03)*	-0.08 (0.04)*
mathematical reasoning test scores		0.57 (0.02)*	0.57 (0.02)*	0.52 (0.02)*	0.44 (0.02)*	0.37 (0.03)*
Interaction: girls × maths test scores				0.12 (0.03)*		
plans involving mathematics						0.26 (0.02)*
instrumental motivations for learning mathematics					0.35 (0.31)*	0.31 (0.02)*
Interaction: girls × instrumental motivations for learning mathematics					0.12* (0.012)	
Constant	0.03	-0.07	0.01	0.01	0.04	0.08
r^2	0.05	0.30	0.32	0.34	0.48	0.53

* $p < 0.05$.

Table A.15

The table shows the odds ratio values for girls' and boys' mathematical school and career plans. Respondents were asked to select the statement that best describes their future school and career plans (*PISA 2012: Technical Report*). The analysis includes controls for performance on the mathematical reasoning test. Gender is coded as a zero-one value where 1 was assigned to males. Statements are in the form of zero-one variables, where a value of 1 refers to choices involving mathematics.

An odds ratio value higher than 1 means that the boys had a greater chance of choosing a given statement.

TABLE A.15. ODDS RATIO VALUES OF REALISING EDUCATION AND CAREER PLANS INVOLVING MATHEMATICS (N = 4607, STANDARD ERRORS IN PARENTHESES)

Study participants referred to the following statements:	
I intend to take additional mathematics/Polish courses after school finishes.	1.35 (0.11)*
I am willing to study harder in my mathematics/Polish classes than is required.	2.13 (0.15)*
I plan on majoring in a subject that requires mathematics/science skills.	2.03 (0.16)*
I plan on taking as many mathematics/science classes as I can during my education.	1.76 (0.13)*
I am planning on pursuing a career that involves a lot of mathematics/science.	2.19 (0.18)*

* $p < 0.05$.

Table A.16

The table shows the values of the linear regression coefficients. The explained variable is a scale made up of three statements that the participants in the study referred to: "I am a good reader"; "I am able to understand difficult text"; "I read fluently", which have been scaled using the item response theory (IRT); (for more information on the scales see: *PISA 2018: Technical Report*). The analysis was controlled for students' social status, including economic, social, and cultural capital.

Model 1 includes the value of the gender coefficient. Model 2 includes the estimated value for reading score. Model 3 includes both variables. Model 4 includes the interaction between gender and reading test score. The reading comprehension test score had a mean of 0 and a standard deviation of 1. Gender is zero-one variable, with a value of 1 being assigned to girls.

TABLE A.16. SELF-ASSESSED READING SKILLS OF 15-YEAR-OLDS IN PISA 2018 – LINEAR REGRESSION (N = 5625, STANDARD ERRORS IN PARENTHESES)

	Model 1	**Model 2**	**Model 3**	**Model 4**
girls	0.3 (0.02)*		0.2 (0.02)*	0.19 (0.02)*
reading comprehension test score		0.32 (0.01)*	0.31 (0.14)*	0.31 (0.02)*
Interaction: girls × reading comprehension test score				0.062 (0.02)*
Constant	-0.29	-0.14	-0.24	-0.25
r^2	0.08	0.17	0.18	0.17

* $p < 0.05$.

Table A.17

The table shows the values of the linear regression coefficients. The explained variable is the Maths Anxiety Scale, which was created on the basis of the statements made by the participants in the study (15-year-old male and female students): "I often worry that it will be difficult for me in mathematics classes"; "I get very tense when I have to do mathematics homework"; "I get very nervous doing mathematics problems"; "I feel helpless when doing a mathematics problem"; "I worry that I will get poor grades in mathematics". These statements were converted to scale using the IRT procedure (*PISA 2012: Technical Report*). A higher value on the scale indicates a greater intensity of anxiety.

The explanatory variables in the models are the student's gender, coded as 0-1 (girls are assigned a value of 1), and standardised scores in the mathematical reasoning test (mean 0 and standard deviation 1). The analysis includes controls for the social status of the students, including economic, social, and cultural capital.

Model 1 includes a coefficient value for gender. Model 2 includes an estimated value for mathematical reasoning score. Model 3 includes both variables. Model 4 includes the interaction of gender and mathematics test score.

TABLE A.17. MALE AND FEMALE STUDENTS' MATHEMATICS ANXIETY AS DECLARED IN PISA 2012 – LINEAR REGRESSION (N = 3032, STANDARD ERRORS IN PARENTHESES)

	Model 1	Model 2	Model 3	Model 4
girls	0.11 (0.04)*		0.06 (0.03)	0.06 (0.03)
mathematical reasoning test score		-0.54 (0.02)	-0.54 (0.02)	-0.51 (0.03)
Interaction: girls × maths test score				-0.07 (0.03)*
Constant	-0.07	-0.04	-0.07	-0.07
r^2	0.00	0.28	0.28	0.28

* $p < 0.05$.

Table A.18

The table shows the values of the linear regression coefficients. The explanatory variable is a scale of exam anxiety based on statements made by students in PISA 2015: "I get very tense when I study for a test"; "I get nervous when I don't know how to solve a task at school"; "Even if I am well prepared for a test, I feel very anxious"; "I often worry that it will be difficult for me taking a test"; "I worry that I will get poor grades at school". A higher value on the scale indicates greater anxiety.

Achievement orientation is a scale based on the following statements: "I want top grades in most or all of my courses"; "I want to be able to select from among the best opportunities available when I graduate"; "I want to be the best, whatever I do"; "I see myself as an ambitious person"; "I want to be one of the best students in my class". Higher values on the scale indicate greater achievement orientation. Statements from the scales were transformed using the IRT procedure (*PISA 2015: Technical Report*). Model 1 includes the student's gender, coded zero to one. Model 2 includes the effect of reading comprehension score and gender on test anxiety intensity. Model 3 includes the latter variable and mathematics test score. Model 4 explains the effect of the interaction between gender and mathematics test score. Model 5 includes gender, test scores in both domains, and the effect of achievement orientation.

TABLE A.18. TEST ANXIETY OF MALE AND FEMALE STUDENTS DECLARED IN PISA 2015 – LINEAR REGRESSION (N = 4434, STANDARD ERRORS IN PARENTHESES)

	Model 1	Model 2	Model 3	Model 4	Model 5
girls	0.39 (0.02)*	0.43 (0.03)*	0.37 (0.03)*	0.43 (0.02)*	0.34 (0.03)*
mathematical reasoning test score			-0.17 (0.01)*		-0.21 (0.02)*
reading comprehension test score		-0.12 (0.01)*		-0.13 (0.02)*	0.05 (0.02)
Interaction: girls × reading comprehension test score				0.08 (0.03)*	
achievement orientation					0.13 (0.02)*
Constant	-0.31	-0.32	-0.29	-0.04	-0.28
r^2	0.05	0.06	0.07	0.06	0.09

*$p < 0.05$.

Table A.19

The table presents the coefficients of a linear regression in which the explanatory variable is a scale formed from the responses to the statements: "When I am failing, I worry about what others think of me"; "When I am failing, I am afraid that I might not have enough talent"; "When I am failing, this makes me doubt my plans for the future". The scale was created using the IRT method (*PISA 2018: Technical Report*).

The explanatory variables in the models are the scores obtained by male and female students in the mathematical reasoning and reading comprehension tests. The variables used in the analyses have a mean of 0 and a standard deviation of 1. Model 1 estimates the effect of zero-coded gender. Model 2 includes reading test score in addition to this variable. Model 3 estimates the effect of mathematics test score. Model 4 explains the level of anxiety by taking into account students' gender, reading score, and the interaction of these variables.

TABLE A.19. FEAR OF FAILURE REPORTED BY MALE AND FEMALE STUDENTS IN PISA 2018 – LINEAR REGRESSION (N = 4434, STANDARD ERRORS IN PARENTHESES)

	Model 1	Model 2	Model 3	Model 4
girls	0.42 (0.03)*	0.43 (0.03)*	0.37 (0.03)*	0.39 (0.03)*
mathematical reasoning test score			-0.2 (0.01)*	
reading comprehension test score		-0.14 (0.02)*		-0.16 (0.02)*
Interaction: girls × reading comprehension test score				0.09 (0.04)*
Constant	-0.30	-0.27	-0.21	-0.26
r^2	0.05	0.07	0.06	0.06

* $p < 0.05$.

Summary

This book focuses on two issues related to gender differences in education. The first is the advantage of females at the tertiary level, and the second is the underrepresentation of women in maths. This book analyses these phenomena in the Polish context. The first part of the work compares the educational pathways of women and men in the 20th century from a horizontal perspective, i.e. school levels. The comparison shows both women and men have been making different schooling decisions since the introduction of the universal and public education system in Poland after the World War II. Women were permanently more likely to choose secondary schools while men were more prone towards basic vocational schools. This difference was inherited from generation to generation and gave women an advantage in the secondary stage. Hence, when in the mid-1990s the system of higher education began to transform from the elite to the mass system, more females than males had *matura* and were allowed to enrol. As a result, women constitute more than a majority of students and about 60% of graduates.

KEYWORDS:

- education
- gender gap
- STEM
- mathematics
- school decisions

Based on the empirical material and previous studies, I explain the differences in gendered school decisions looking at their unprivileged position in the labour market ("hedge hypothesis") and better adaptation to school culture.

In the second part of the work, I address the issue of gender differences in educational achievements, particularly in mathematics. Although this subject plays a special role in the school system due to its relevance in economic progress and offer of attractive benefits, it is still overrepresented by males. The book explains this pattern by looking at the school achievements and psychological functioning of both genders in the school context. The analyses show that women with sufficient mathematical skills to pursue maths careers are more likely to avoid maths because, more than their male counterparts, they are negatively affected by the combination of psychological (including uncertainty of mathematical competences, fear of competition), social (stereotypes), and institutional factors (school tracking).

Biogram

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Alicja works in the Department of Cognitive Sociology at the Institute of Sociology, University of Bialystok. Her research interests focus on social inequality, mobility, and structure. She is the author of a number of articles on gender inequalities in access to education, especially in technical studies and mathematics, including: *Poczucie skuteczności i pozytywne autostereotypy – przypadek kobiet w naukach ścisłych i technicznych* [Sense of efficacy and positive self-stereotypes – the case of women in science and technology]; *Znajomi, przyjaciele, Partnerzy – charakterystyka relacji w obrębie wewnętrznych kręgów społecznych* [Acquaintances, friends, partners – characteristics of relationships within inner social circles]; *Filtered out, but not by skill: the gender gap in pursing mathematics at a high-stakes exam*. The analyses she conducts are multi-disciplinary, combining psychological, economic, and historical approaches.

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